



RA400 Rail-Max

Tracked Excavator



*****DRAFT*****

Operator's Manual

Part no. RAMAX400-001
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Original Instructions (English)

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1 Introduction

This Operator's Manual has been compiled for the purposes of safe operation, maintenance and servicing of Rail-Ability components and systems.

For other operating details (e.g. machine, Boom, Road Rail Operations, Rail Gear, etc.) refer to the publications listed in section 4.

Left or right are to be with the reader sitting in the driver's seat in the cab facing forwards, looking over the front floating axle unless otherwise stated.

IMPORTANT

READ, UNDERSTAND AND OBEY THE CONTENTS OF THIS OPERATOR'S MANUAL BEFORE THE OPERATION OF THIS MACHINE.

ONLY TRAINED AND AUTHORISED PERSONNEL SHALL BE PERMITTED TO OPERATE THIS MACHINE.

THIS MACHINE IS VERY COMPLEX AND POTENTIALLY DANGEROUS. IT IS IMPORTANT THAT BEFORE ANY USE OF THE MACHINE OCCURS, EXCEPT TRANSPORTATION AND ATTACHMENT HANDLING, THE FOLLOWING ACTIVITIES HAVE ALL BEEN PERFORMED AND CARRIED OUT IN THE ORDER STATED:

1. Pre-Operation Actions
2. Routine Maintenance as determined by the Pre-Operation Actions
3. Function Tests
4. Workplace Assessment
5. Operating Instructions.

THIS MANUAL SHOULD BE CONSIDERED A PERMANENT PART OF THIS MACHINE AND SHOULD REMAIN WITH THE MACHINE AT ALL TIMES.

Should you have any questions, contact Rail-Ability Ltd:

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The Rail-Ability web site is www.railability.co.uk.

2 Description and Intended Use

The Rail-Ability Rail-Max machine consists of a road-going tracked excavator ridged chassis, modified for use on rail by Rail-Ability Ltd as detailed in section 4. The chassis is fitted with rail gear front and rear to enable rail work. Various attachments can be mounted onto the boom and these are delta with collectively. For further information concerning attachments, see the manuals detailed in section 4.

The Rail-Max is intended for use on and off-track and/or rail wheels to enable operators and personnel to undertake maintenance work underneath overhead lines and structures forming part of the rail infrastructure.

The Rail-Max complies with the provisions of the following EC Council Directives:

- **Electromagnetic Compatibility (EMC)** **2004/108/EC**
- **Noise Emission in the Environment by Equipment for use Outdoors** **2000/14/EC.**

3 Limitations

The use of this machine is limited to its intended use, as described above. If additional or special applications or uses are required which are not covered by this Operator's Manual, carefully analyse the situation and refer to Rail-Ability Ltd for advice before proceeding.

Operational and environmental limitations of the equipment are described in the Specifications section of this manual.







4 Manuals

Title	Part No
Rail-Ability RA400 Rail-Max Tracked Excavator Operator's Manual (this manual) Issue 1 - November 2014 - Original Instructions (English)	RAMAX400-001
Rail-Ability Rail Max RA400 Routine Maintenance Plan Issue 1 - 1 July 2014	RARM400RMP001
Rail-Ability RA400 Rail-Max Tracked Excavator Parts Manual 1st Edition	XXXXX
HOST MACHINE: MAINTENANCE INFORMATION:	
Excavator	Publication No. 9803/6580-5, JX235/JZ255, for machines with serial numbers in the range 1234500 to 1235499
Engine Manuals	Isuzu 4HK1X - Tier III Engine Service Manual, part number - 0297 9912, 3rd edition, 03/03 and the Engine Parts Manual, part number- 0312 0836, 1st edition, 01/03
Prolec RCI	Prolec Liftwatch Rail Rated Capacity Indicator Operators Manual, 560386-000 Issue 1.2, dated Feb 2011
Steel wrist Operator Hand Book	Steel wrist Operator Hand Book

Be sure the Operator's and Safety manuals are complete, legible and located with the machine.

5 Decal Legend

The decals on this machine use symbols, colour coding and signal words to identify the following:

	<p>Red with safety alert symbol – used to indicate the presence of an imminently hazardous situation which, if not avoided, will result in death or serious injury.</p>
	<p>Safety alert symbol – used to alert personnel to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.</p>
	<p>Orange with safety alert symbol – used to indicate the presence of a potentially hazardous situation which, if not avoided, could result in death or serious injury.</p>
	<p>Yellow with safety alert symbol – used to indicate the presence of a potentially hazardous situation which, if not avoided, may cause minor or moderate injury.</p>
	<p>Yellow without safety alert symbol – used to indicate the presence of a potentially hazardous situation which, if not avoided, may result in property damage.</p>
	<p>Green – used to indicate operation or maintenance information.</p>

These symbols are also used in this manual as an appropriate visual indication and their meaning is as detailed above.

Be sure all decals, including those shown in the Decals Section of this manual, are in place and legible.

6 Safety Rules



DANGER. FAILURE TO OBEY THE INSTRUCTIONS AND SAFETY RULES IN THIS MANUAL MAY RESULT IN DEATH OR SERIOUS INJURY.

6.1 General

- Read, understand and obey all applicable governmental regulations.
- Read, understand and obey the employer's safety rules and worksite regulations.
- Comply with the employer's, job site and governmental rules regarding use of personal protective equipment.
- Read, understand and obey the manufacturer's instructions and safety rules, safety and operator's manuals and machine decals.
- Learn and practice the principles of safe machine operation contained in this operator's manual.
- Be properly trained to safely operate the machine.
- Always obey national traffic regulations while driving the machine on roads. Be aware of the machine's overall length, width and height.
- Avoid hazardous situations.
- The lack of maintenance may cause damage or hurt people.
- **Know and understand the safety rules before going on to the next items:**
 - Prior to use:
 - Always perform Pre-Operation Actions
 - Always perform Function Tests
 - Always perform a Workplace Inspection.
 - Only use the machine as it was intended:
 - Do not engage in stunt driving or misbehave while operating the machine.

6.2 Electrocution Hazards

- This machine is **NOT** electrically insulated and will **NOT** provide protection from contact with or proximity to electrical current.
- When in operation maintain the minimum safe distances from electrical power lines and apparatus in accordance with the applicable governmental regulations and Figures 1 and 2 below.

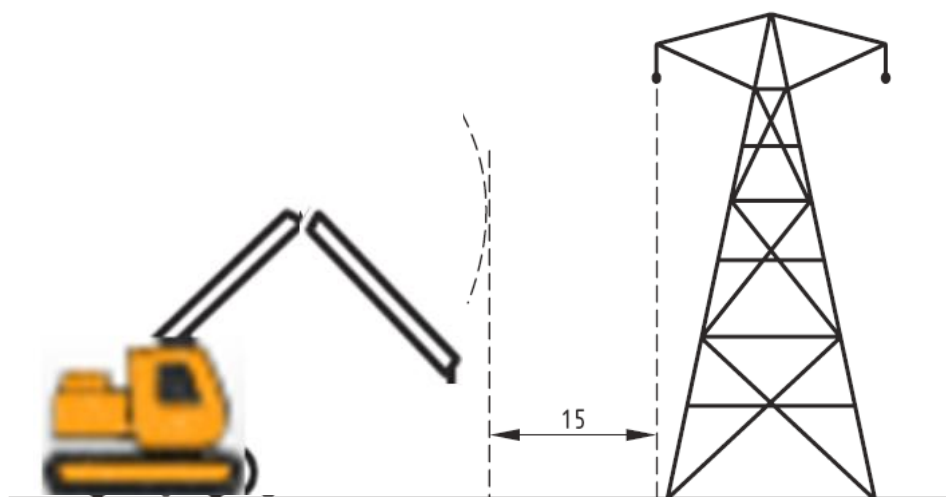


Figure 1 - Safe Distance (metres) from Power Lines in excess of 33kV on Steel Towers

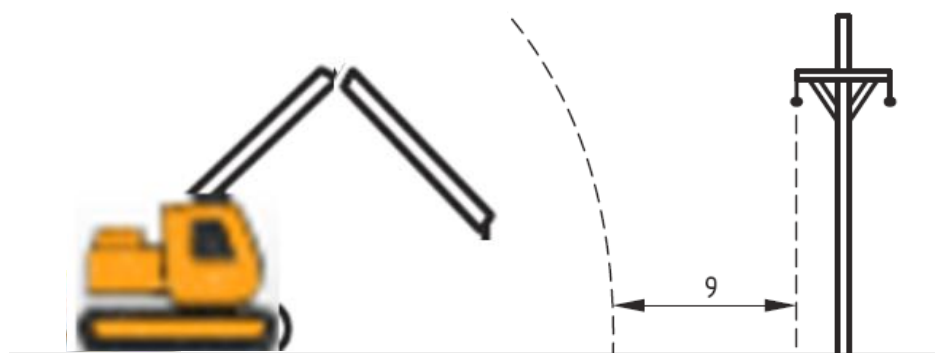


Figure 2 - Safe Distance (metres) from Power Lines up to 33kV on Wooden Poles

- Personnel must carefully evaluate the danger of electrocution before moving. If closer than 10 metres from the boom, the machine, the load or the electric line, move at least 10 metres away, by shuffling away with small steps, in order to minimize the chance of getting a high voltage difference between the feet.
- OLE lines on rail are 25kV and require a minimum safe approach distance of 2.75 metres.
- Allow for platform movement, electrical line sway or sag.
- **Keep away from the machine if it contacts energised power lines. Personnel on the ground or in the platform must NOT touch or operate the machine until energised power lines are shut off.**
 - Do not attempt to assist someone in direct or indirect contact with the power line before the power has been disabled as you run the risk of being electrocuted yourself.
 - Warn others to stay away.
 - Call for help.
 - Contact the power company to de-energize the line.
 - If you are in the machine cabin, stay inside without touching the machine body because it's extremely hazardous to go out before the line is de-energised.
 - Help the electrocuted person if you know the first-aid procedures, otherwise wait for the paramedics to arrive.
- Do not operate the machine during lightning or storms.
- **Refer to Engineering Acceptance Certificate for live OLE limitations.**

- Inspect daily for damaged cables and wires. Replace damaged items before operating.
- Avoid contact with electrical terminals.
- Earth bonding straps:
 - Straps must be in place at all times and securely fastened.
 - Inspect the straps daily.
 - Replace straps immediately if there are any signs of burning or damage.
 - Replace damaged straps before operating.
 - Check impedance levels after refitting any straps.
 - Earth bonding straps are fitted on the machine in the following positions:
 - Between front rail axle and chassis
 - Between machine upper structure and continuously along the boom
 - Between second stage boom and arm.
- Avoid electrical shock from contact with battery terminals. Remove all rings, watches and other jewellery.
- Ensure a C Form has been obtained before on-tracking the machine in OLE areas.

6.3 Travel Hazards

- Observe and use colour-coded direction arrows on the machine for drive functions.
- Be aware of limited sight distance and blind spots when driving. Use a 'banksman' or machine controller when required.
- Limit travel speed according to conditions, slope, location of personnel, and any other factors which may cause collision.
- If a hook protrudes outside the edge of the machine, it must be removed before travelling.
- Take care while travelling on rail, especially when the boom is elevated.
- Beware of slippery and limited traction conditions on rail. Braking distance can increase significantly in wet or icy conditions.

6.4 Tip-over Hazards

- Do not alter or disable the safety switches (e.g. limit and proximity switches).
- Do not alter or disable machine components that in any way affect safety and stability.
- Do not replace items critical to machine stability with items of different weight or specification. If in doubt, contact Rail-Ability Ltd.
- Do not modify or alter this machine without prior written permission from Rail-Ability Ltd.
- Ensure that all tracks are in good condition, track nuts (including rail wheels) are properly tightened (see specifications section of this manual).
- Do not drive the machine on temporary track, uneven or unstable track or other hazardous conditions with the boom raised.
- Do not use the machine while mounted on another moving surface of a machine.

6.5 Fall Hazards

- Always sit in the seat and fasten the seat-belt when operating the cab controls.
- Always use the steps and handholds provided when accessing and exiting the machine bonnet or cab. Never climb onto the rear by other means or jump from the cab onto the ground.
- Machine deck:
 - Take care when on the deck (when performing inspection or maintenance), particularly in wet or icy conditions.
 - Remove or secure any loose equipment or tools that could fall off during transit or present a trip hazard.
 - Clean up any oil or other fluid spillages on the deck which could create a slippery surface.
 - Keep the deck clean and tidy.

6.6 Collision Hazards

- Check the work area for overhead obstructions or other possible hazards.
- Do not operate the machine in the path of any boom or other moving machinery unless the controls of that machinery have been locked out and/or precautions have been taken to prevent any potential collision. Use a 'banksman' or machine controller to alert the operator/driver when required.
- Boom:
 - Be aware of limited sight distance and blind spots when operating the boom. Use a 'banksman' or machine controller when required.
 - Be aware of boom position and tail-swing when slewing.
 - Do not lower the boom unless the area below is clear of personnel and obstructions.

6.7 Crushing Hazards

- Keep hands and limbs away from moving parts of the machinery.
- Maintain safe distances between the operator, the machine and fixed objects.
- Use common sense and planning when operating the machine with a 'banksman' or controller from the ground.

6.8 Explosion and Fire Hazards

- Do not start the engine if you smell or detect diesel fuel or other explosive substances.
- Do not refuel the tank(s) when the engine is running.
- Refuel the tank(s) and charge the battery only in an open, well-ventilated area away from sparks, flames and lighted tobacco.
- Do not operate the machine in hazardous locations or locations where potentially flammable or explosive gases or particles may be present.
- Do not spray ether into engines equipped with glow plugs.
- Keep sparks, flames and lighted tobacco away from the batteries as batteries emit an explosive gas.
- Do not contact the battery terminals or the cable clamps with tools that may cause sparks.

6.9 Burn Hazards

- As batteries contain acid, always wear protective clothing and eye wear when working with batteries.
- Avoid spilling or contacting battery acid.
- Neutralise battery acid spills with baking soda and water.
- Do not expose batteries to water or rain.

6.10 Bodily Injury Hazards

- Be aware of Crushing Hazards when grasping any part of the boom or track frame.
- Do not operate a machine with a hydraulic oil or air leak as a hydraulic leak can penetrate and/or burn skin and air which enters the body can cause death or serious injury.
- Improper contact with components under any cover will cause serious injury. Only trained maintenance personnel should access compartments. Access by the operator is only advised when performing a pre-operation inspection.
- All compartments must remain closed and secured during operation.
- Always operate the machine in a well-ventilated area to avoid carbon monoxide poisoning.

6.11 Lifting Hazard

- Use the appropriate number of people and proper lifting techniques when lifting:
 - batteries
 - drawbars
 - tools
 - other removable items.

6.12 Damaged or Malfunctioning Machine Hazards

- Do not use a damaged or malfunctioning machine.
- Tag and remove from service a damaged or malfunctioning machine.

6.13 Component Damage Hazards

- Do not use any battery or charger greater than 24V to jump-start the host machine OEM engine detailed in section 4.

7 Rail Safety



DANGER. FAILURE TO OBEY THE INSTRUCTIONS AND SAFETY RULES IN THIS MANUAL MAY RESULT IN DEATH OR SERIOUS INJURY.

Failure to comply with these requirements may result in severe damage to the machine and/or the rail infrastructure.

7.1 General

- All work on or near the railway infrastructure must be carried out strictly in accordance with railway regulations.
- Always observe Network Rail codes of practice.
- Work must be carried out in accordance to rulebook GE/RT 8000 and all safety precautions must be followed at all times.
- Attention must be paid to Railway Group Standards and all safety precautions must be followed at all times.
- All staff must be fully trained and certified as competent to use this piece of equipment on railway infrastructure by the owner/operator.
- When working on electrically operated routes, be sure to observe official regulations. Always observe minimum clearance from overhead wires.
- Ensure a relevant C Form is obtained.
- Never use in 3rd and 4th rail areas.
- Never use on track without a possession.
- Never use on track under live OLE.
- Never use on track when trains are running.
- Never On/Off-Track in areas with close proximity hazards such as in station platforms under/on bridges, in tunnels or in areas with low overhead structures or line side structures.

See the Network Rail V.A.B. Engineering Acceptance Certificate and EC Type Examination Certificate for additional, specific machine limitations of use.

7.2 On/Off Track

- Always utilise an approved On/Off-Tracking method.
- Never On/Off-Track in areas with any cable connections to the rail.
- Never On/Off-Track in areas with ATP loop cables either in the rail web or in the "four foot".
- Never On/Off-Track in areas with any cables cleated to the top surfaces of sleepers.
- Never On/Off -rack in areas with any signalling equipment fitted in the "four foot".

7.3 Travelling on the Rail

Before travel commences, ensure the following:

- Crowd ram fully extended so that bucket is fully crowded round.
- Dipper ram fully extended so that the dipper is fully in.

- Tab second stage arm rams fully retracted so that second stage is fully out.
- Main lift ram set so that the bucket is approximately 300mm above the rail head so that the arm is positioned below the highest point of the cab.
- Rail Gear deployed fully.

WARNINGS: (1) TO ENSURE THE MACHINE IS COMPLYING WITH THE W6A GAUGE REQUIREMENT, BEFORE TRAVELLING ON RAIL, IT IS ESSENTIAL THAT THE MACHINE IS SLEWED SO THAT THE UPPER STRUCTURE IS PARALLEL TO THE LOWER STRUCTURE AND THAT THE CAB DOOR IS SHUT TO ENSURE THIS IS MAINTAINED. IT IS ALSO ESSENTIAL THAT THE ARM IS POSITIONED LOWER OR EQUAL TO THE HEIGHT OF THE CAB. THIS IS TO ENSURE OVERHEAD STRUCTURES ARE NOT STRUCK. THE PROLEC HEIGHT LIMITER FITTED TO THE MACHINE CAN THEN BE SET AND ACTIVATED TO MAINTAIN THIS POSITION.

(2) EXTRA CARE AND OBSERVATION OF LINE SIDE AND OVERHEAD STRUCTURES IS REQUIRED WHEN THE MACHINE IS FITTED WITH AN ATTACHMENT THAT IS OUTSIDE THE W6A TRAVEL GAUGE IN ANY WAY.

(3) FAILURE TO COMPLY WITH THESE REQUIREMENTS MAY RESULT IN SEVERE DAMAGE TO THE MACHINE AND/OR THE RAIL INFRASTRUCTURE.

8 Boom Safety

8.1 Requirements

- The machine operator shall be held directly responsible for the correct operation of the boom including any requirements of the site conditions.

8.2 General

Adhere to the following items in order to avoid possible accidents while operating the boom.

- **Do not interfere with the safety and protection devices.** Note that interference with the check valves and removal of the lead seal removes and invalidates the Manufacturer's warranty.
- Only authorized persons are allowed to operate the boom.
- The machine must be used on firm ground.
- Check that the machine brake is on and that the tracks are locked.
- Before every operation make sure that:
 - no-one is within the working area of the boom
 - the safety devices are in place and operative
 - the minimum safe working distances from power lines are observed
 - the load is correctly slung and hooked.
- Stabilize the machine by making sure that the rail wheels are properly positioned on the track.
- Use the boom in accordance with the use and maintenance manual, making sure that:
 - the load and radius are within the maximum limits shown on the load chart
 - the boom is used progressively, avoiding sudden load movements
 - swinging or dragging of the load is avoided
 - the load is lifted before rotating.
- When using implements, set up an exclusion zone.
- The machine is not left unless the load is on the ground.
- Before driving the machine make sure that the boom is in the folded position.
- The use of the boom is reserved for authorized personnel, instructed in advance, who must conform to the safety norms and instructions contained in the manual supplied with the boom (see norms ISO 9926-1).
- It is prohibited to walk or stop under a suspended load.
- It is prohibited for unauthorized persons to be within the working area.
- Warning, instruction and operation plates must be replaced when no longer readable or missing. Contact Rail-Ability to replace any missing plates.
- When transporting the machine, to avoid hitting bridges or tunnels know the overall height of the boom in the folded position or in laid position in the body. Always respect and pay proper attention to road signs placed in proximity of such obstacles.

8.3 Residual Risks

It is forbidden to use the boom without having read and understood the manual for use and maintenance and without having being previously instructed by experienced personnel on all aspects of safe boom operation.

Risk evaluation shall be followed by adequate provisions in order to avoid risks and damage to people and objects.

- **Overturn:** the boom can overturn, thus hurting people and damaging objects especially in the following conditions:
 - not correctly railised
 - moment limiting device disabled
 - ground conditions at the site not stable enough
 - excessive speed.
- **Moment limiting device:** never try to bypass or tamper with the moment limiting device and the various safety systems installed on the boom. Understand the alarm messages generated by the "moment limiting device" and act accordingly.
- **Control position:** before operating the controls the operator shall make sure that they are safe from hazards.

From the control position the operator shall be able to visually inspect the whole working area at all times. If it is not possible, they shall team up with a co-worker able to control the whole area and who can see all potential hazards clearly at all times.

- **Load rigging:** carefully inspect the load rigging. The operator shall make sure that the load is properly attached and balanced and that all unexpected movements are not allowed. Be careful not to hit any potential impediments during the boom movements.
- **Overload and/or fatigue:** the boom can break down due to fatigue or overload:
 - if it is misused (with cycles, loads or pump oil flow not pertinent to the boom class)
 - if it is used for improper tasks (side, oblique or reversal pull)
 - if it is used in poor sites (corrosive environment, too high or too low temperature, foundry - see Workplace Assessment)
 - if the load exceeds the rated capacity indicated on the relevant plates.
- **Wrong manoeuvring:** the boom can fall, break or overturn if the operator performs a wrong manoeuvre due to the lack of familiarity with the operation procedures or due to inadequate psychophysical conditions. There are directives and rail regulations in force that impose suitable training of the personnel before using these types of machines and they require an adequate psychophysical condition to operate safely a lifting device that implies an inherent danger when lifting a load.
- **Weather conditions:** too high or too low temperatures may damage the components of the hydraulic and electric circuits. Do not operate the machine during a storm with lightning hazards, and if these condition occur it is recommended that the boom is folded down and put to rest.
- **Shearing, entrapment:** the boom has a lot of parts in movement that it is impossible to protect, therefore the operator shall always be aware of this residual risk and keep clear from the parts in movement, particularly from the load. The operator is held responsible not only for themself but also for those working in proximity of the boom including any that are not authorized.
- **Electrocution:** the boom is not eclectically insulated and therefore it is not equipped to work with conductors, including if a contact is accidental. Be compliant with the minimum clearance prescribed by the national directives in force. Generally speaking the clearance from electric lines of 33kV should be at least 9 metres. Above 33kV, the distance should be at least 15m and

be verified in each case by competent technicians and with respect to the environment conditions.

- **Attachment overload:** attachments are controlled by the moment limiting device only under the conditions described in this manual.
- **Accessories:** be careful when attaching/detaching any accessories (buckets, grabs, etc). First verify the weight, the quick hitch and the instructions. Then appraise their centres of gravity and avoid sudden movements.
- **Breakdown of some sensors:** the moment limiting device is always monitored during operation. The system, after having activated the various circuits, checks the presence of all the inputs and then continuously monitors the operation and the efficiency of the limiting device.

8.4 Before Operating



- **WARNING: Before boom use check that safety and protection devices shown above and detailed below are fitted and active:**
 - Check valve for boom rams
 - Check valve for dipper ram
 - Check valve for cab ram
 - Rotation limiting device
 - Check valves for rotation control (flow regulators)
 - Lifting moment limiting device.
- Keep the steps and the work areas clean.
- Check that the working area is adequate and properly illuminated.
- Carefully inspect the condition of ropes or chains if present.

8.5 During Operation

- Do not run the engine in an indoor area without first making sure there is adequate ventilation.
- If there is inadequate ventilation, take the machine fumes away from the working area by fitting an extension tube of a suitable diameter and of sufficient length to the exhaust system.

- Make sure that no one is within the working area of the boom.

8.5.1 Safe Working Distances

- Avoid swinging the load above working and transit areas, any hidden danger situation must be audibly alarmed.
- Avoid all those situations which may result in crushing during machine stabilization, boom movement and load handling.

Avoid crushing parts of the body by following the minimum safe working distances below (see EN 349 standard for further guidance). The table below indicates the minimum safety working distances concerning the various parts of the body and each figure illustrate circumstances which may turn out to be dangerous if you fail to respect the minimum safe distances.

Part of body	Minimum safe working distance (mm)	Figure	Part of body	Minimum safe working distance (mm)	Figure
Whole body	500		Foot	120	
Head	300		Hand/wrist/fist	100	
Leg	180		Toe	50	
Arm	120		Finger	25	

8.5.2 Load Handling

- Examples of good and poor practices:

Carefully inspect the load rigging. Ensure you follow good practice, such as that shown on the right.	
<p>This item on the right shows poor practice and must not be used.</p> <p>Do not utilize the boom for push/pull, lateral or sideways operations.</p> <p>Crushing or push manoeuvres are not permitted.</p>	

- Hook up the load, checking that it does not exceed the capacity indicated on the lifting diagram specific to each load configuration.
- Make sure that the lifted load is balanced.
- Avoid swinging the load above the control station. In cases where the load is too close, the boom must be operated from the opposite side.
- Do not operate with sudden movements. Activate the controls with slow and progressive movements and rotate slowly and with care paying attention to the stability of the machine.
- With vertical lift, rotate slowly in order to avoid side-skidding.
- Only move the machine when the boom is in transport position.
- **The machine must not be left unless the load is on the ground and the booms are folded and laid on a solid base.**

9 On/Off-Tracking the Machine



9.1 General

- Refer to the manuals detailed in section 4 and adhere to all instructions before commencing on/off tracking.
- Cant – not to exceed 100 mm.
- Adequately prepared Access Point installed.
- Ballast shoulder – high/low identified.
- Deep cess/soft cess identified and avoided
- Drainage routes, troughing routes and other services/cables identified and avoided.
- Care should be taken when on/off tracking s not to damage the railhead, suitable rail shields should be used.
- OHLE power cables acknowledged.
- Switches and Crossings avoided.
- Overhead and close proximity structures and infrastructure observed.
- All work on or near the railway infrastructure must be carried out in accordance with railway regulations.
- Work must be carried out in accordance to rulebook GE/RT 8000 and all safety precautions must be followed at all times.
- When working on electrically operated routes, be sure to observe official regulations. Always observe minimum clearance from overhead wires.
- Never install TAS or on track the machine without a possession.
- All staff must be fully trained and certified as competent to use this piece of equipment on railway infrastructure by the owner/operator.

NOTE: DO NOT ATTEMPT TO MANOEUVRE THE MACHINE WITH THE CRAWLER TRACKS, WHEN THE RAIL GEAR IS SEMI/FULLY DEPLOYED.

9.2 Access Points

- On/Off-Track the machine only at an approved access point.
- An approved access point is one of the following:
 - Hard paved level crossing
 - Yard where surface is level with the top of the rail
 - Proprietary approved track access system with inbuilt rail shields
 - Consolidated ballast to at least the underside of the railhead with rail shields.

10 Emergency Operations

10.1 Recovery Options

The normal method of recovery is available when the machine engine is driving the hydraulic pump and the cab controls are available. Follow the instructions in this manual for normal operations, detailed depending upon which mode of operation is being used.

If the electrical systems have failed, or the engine has failed (e.g. run out of fuel) then the boom may only be returned to its stowed position using the Battery Driven Pump.

There are 2 methods of emergency recovery of the machine both of which use the cab controls. In order of preference these are:

- Machine Engine
- Battery Driven Pump.

To use these systems, the safety systems must be overridden using the RCI Over-ride key switch in the engine bay.

10.1.1 Machine Engine

Using the cab controls:

- Operate the RCI Over-ride key switch.
- Utilise the Machine Engine.

10.1.2 Battery Driven Pump

Where the machine engine has failed using the cab controls:

- Operate the motion cut over-ride latches.
- Utilise the Battery Powered Pump.

10.1.3 Manual Over-ride Latches

In the event of an emergency, loss of power or RCI system failure an over-ride is fitted to this machine to enable the booms to be slewed, retracted and lowered to their stowed positions. This is used in conjunction with various power sources and control mechanisms as detailed above.

The over-ride key is located in the Engine Bay.

Ensure that all personnel, either operating or working alongside this machine, are aware of the location and operation of each of these systems.



THESE OVER-RIDE FEATURES MUST ONLY BE EMPLOYED IN THE EVENT OF AN EMERGENCY, LOSS OF POWER OR RCI FAILURE. THEY ARE NOT CONSIDERED SUITABLE FOR NORMAL USE.

The over-ride key, when activated, allows the operator to bypass the following safety interlock systems on the boom:

- Over-tilt (cant) in both directions
- Motion cuts
- Load sensing system
- Moment sensing system
- Slew restriction.

During an over-ride situation all audible or visual warnings associated with any of the above interlocks will continue to actuate. An additional buzzer will sound whenever an over-ride is active to indicate that the over-ride feature is being activated. Once the over-ride system is activated the data logger will monitor the system.

Note that it is possible to overstress and overturn the machine while the safety systems are overridden. The operator should prioritise the use of the Radius in function wherever possible to assist in correcting the situation.

Once the booms have been lowered to a stowed position, after the over-ride key has been activated, the blue LED strip will be off indicating that the machine is overridden. The machine must be inspected and reset by Rail-Ability Ltd prior to being put back into service.



Figure 3 - Engine Bay Over-ride Button Location

10.2 Battery Driven Pump

The battery driven hydraulic pump is activated via the in cab onscreen display auxiliary hydraulics function menu.

The electric pump will not run if the main pumps are operating or if the batteries are discharged below 21 volts.

10.3 On Rail Recovery

10.3.1 Towing

- Refer to the manuals detailed in section 4 and adhere to all instructions before commencing towing.
- Ensure that the towing machine is connected with the tow bar before the rail brakes are released via hub disengagement, to enable towing to commence:
 - A Network Rail pattern tow bar is located at the rear of the machine
 - Only use the rigid tow bar provided
 - Tow eyes and pins are fitted to the front and rear of the machine.

- Do not exceed 10 km/h (6 mph)
- Use the appropriate number of people and proper lifting techniques when lifting the tow bar.
- The tow bar must remain with the machine at all times and must never be removed unless when actually towing.

If the main hydraulic pump is not functioning, use the Electric Power option as detailed below.

10.3.2 Electrical Power

In case of failure of the main hydraulic pump or engine failure:

- Raise the rail gear using the Battery Driven Pump with cab Levers detailed previously.
- Use the Rail Gear Recovery Controls in order to Off-Track the machine.

10.4 Emergency Off Tracking

EMERGENCY ON-TRACKING IS NOT COVERED IN THIS MANUAL AS THERE IS NO OCCASION WHEN THIS PROCEDURE WOULD BE CONDONED.

Emergency Off-Tracking however may be necessary at some point. It must be stressed that this is an **Emergency Procedure Only** and should **NOT** be used for normal operation. If you are asked to Off-Track using this method (at an unprepared location) without suitable justification you should report to your On-call Manager and ask their advice before attempting this manoeuvre.

Carry out the preparation below, then the procedure.

10.4.1 Preparation

If there is real cause to use this method there are still certain procedures that must be followed:

- The Off-Tracking area must be inspected for its suitability as normal
- An area where there are no obstructions should be selected. For example, there should be no conductor rail present, no high ballast shoulders and no obvious hazards
- Emergency Off-Tracking must not be carried out on a cant.
- Emergency Off-Tracking must not be undertaken with attachments other than a bucket.

10.4.2 Procedure

In the event of a real emergency the procedure for Emergency Off-Tracking is as follows:

- Ensure the machine is configured for travel (boom fully stowed)
- Approach the Off-Tracking area at a safe speed
- Sound the horn to alert personnel at the Off-Tracking area as you approach
- Raise the front and rear rail gear fully
- Turn the machine keeping the tracks on the railhead.
- Manoeuvre the machine on the railhead until the machine is perpendicular to the rail.
- Slowly track the machine clear of the running rail.
- Move the machine at least 3 metres from the closest rail.

When carrying out this operation always follow any hand signals given by a 'banksman' or machine controller and carry out all movements smoothly and at a safe speed. The machine is fitted with an offset boom and the arm must be centred to avoid causing instability or a possible tip-over situation occurring.

Ensure you are clear of all obstructions.

Ensure the machine is configured to travel to avoid causing instability or a possible tip over situation occurring.

THIS MANOEUVRE IS DANGEROUS AND MUST ONLY BE CARRIED OUT IN A REAL EMERGENCY.

When Off-Tracking, care must be taken when the machine manoeuvres off the railhead. Make certain that the rail bogies are raised up to the maximum height for travel.

If the machine tips or tilts forward severely onto the track while climbing off the rail head and the weight of the machine is exerted excessively onto the track components, severe damage to the infrastructure may result.

'Grounding out' the machine, while the machine is travelling off rail may result in severe damage to the machine and/or infrastructure.

11 Machine Overview

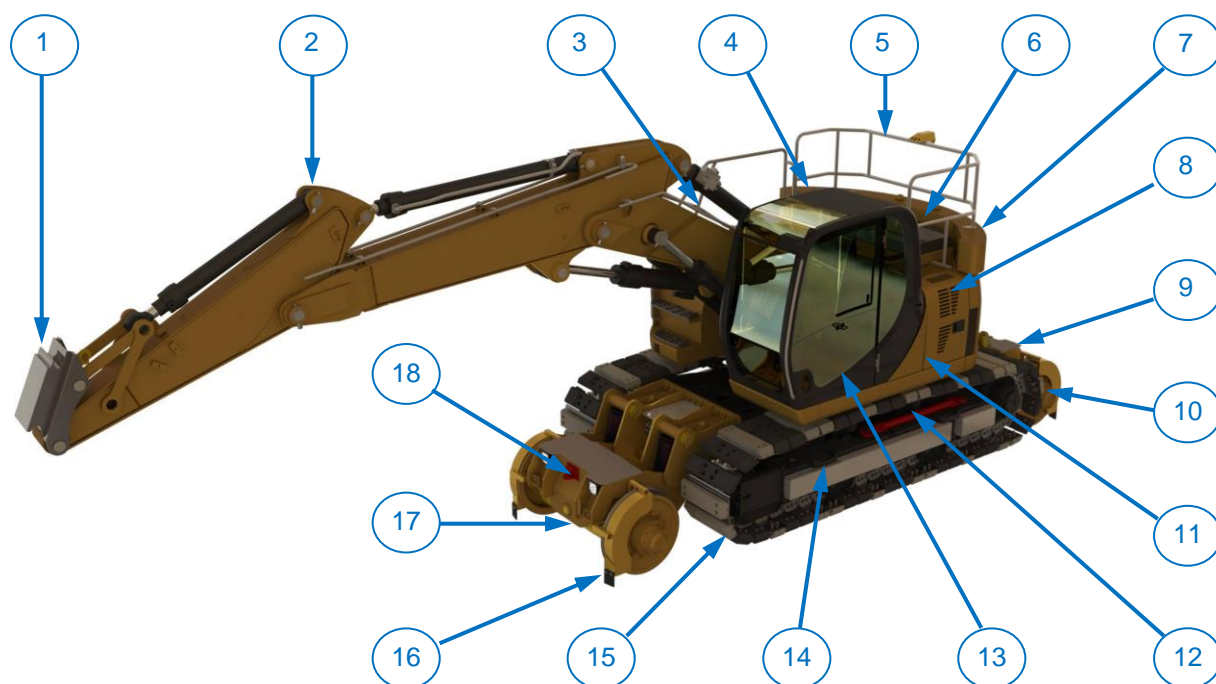


Figure 4 - Location of Machine Components

- | | | |
|--------------------------|----------------------|------------------------|
| 1. Quick Hitch | 7. Counterweight | 13. Cab |
| 2. Boom | 8. Engine | 14. Cab Access Step |
| 3. Top Deck Access Steps | 9. Rear Tow Coupling | 15. Tracks |
| 4. Hydraulic Oil Filler | 10. Rear Rail Gear | 16. Track Sweepers |
| 5. Top Deck Handrails | 11. Batteries | 17. Front Rail Gear |
| 6. Fuel Filler | 12. Draw Bar | 18. Front Tow Coupling |

12 Control Layout

There is one set of normal (non-emergency) controls on this machine in the cab and one set of manually operated emergency recovery controls for the rail gear outside the cab.

12.1 Cab Controls

Within the cab there are controls and displays which are detailed in the following paragraphs.

- NOTES:
1. The machine engine should not be running when grabs/attachments hydraulics are connected and disconnected.
 2. For all other functions – refer to the JCB JZ235 operator hand book.



Bucket / Grab Diverter Activation

Red Light = Grab active

Tilt rotator attachment release switch

The quick hitch attachment release is operated using the JCB systems

Figure 5 - In-Cab Controls

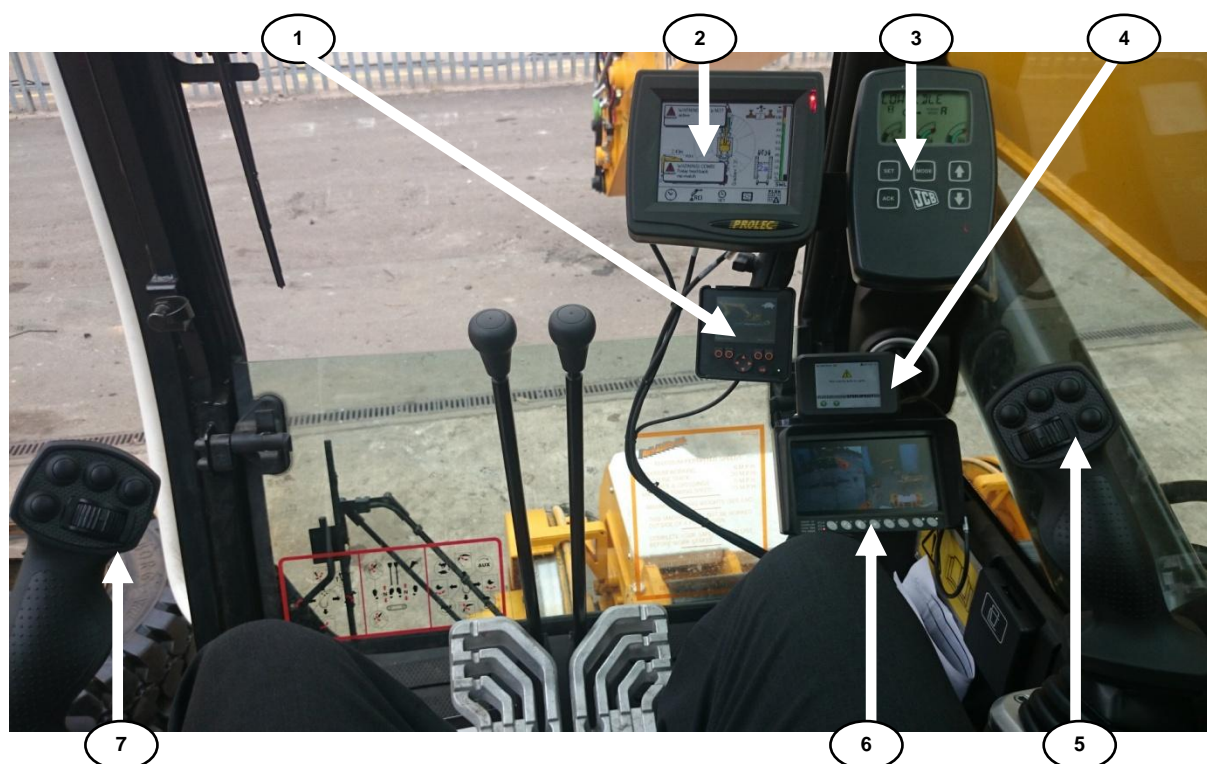
12.2 Emergency Stop

Disables all rail control functions and stops machine movements, see Fig.6.



Figure 6 - In-Cab Dashboard Emergency Stop Button

12.3 Auxiliary Interface Controls



- | | |
|--|--|
| 1. Rail-Ability Rail Systems Interface | 5. Right hand lever |
| 2. PROLEC RCI Display | 6. Side and Rear blind spot Camera Interface |
| 3. JCB Machine Interface | 7. Left hand lever |
| 4. Steel Wrist Tilt Rotator Interface | |

Figure 7 - In-Cab Auxiliary Controls

The extra tilt rotator/extend functions are operated using the 4 auxiliary rollers on top of the left and right hand levers (see Figures 8 and 9).

For other auxiliary functions, refer to the steel wrist operator hand book.

The Prolec RCI instructions are given in the Prolec lift watch rail operator hand book.

12.4 Rail Gear Controls Interface

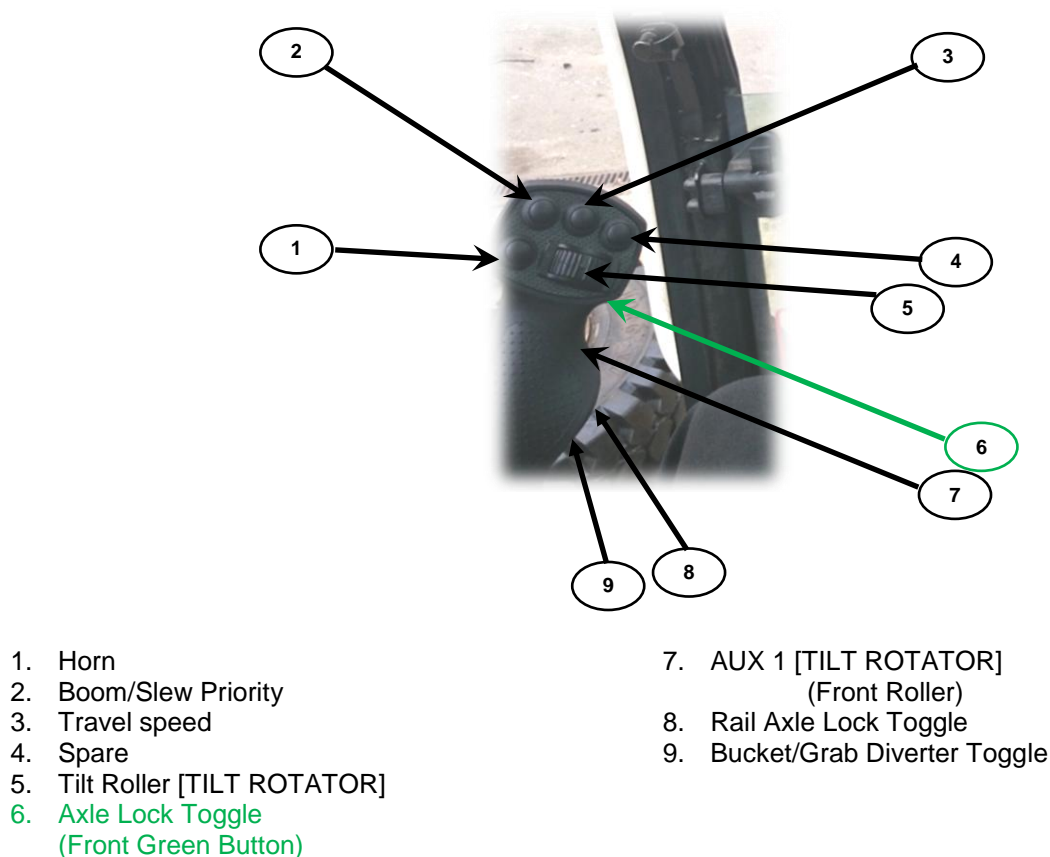


Figure 8 - Left hand lever

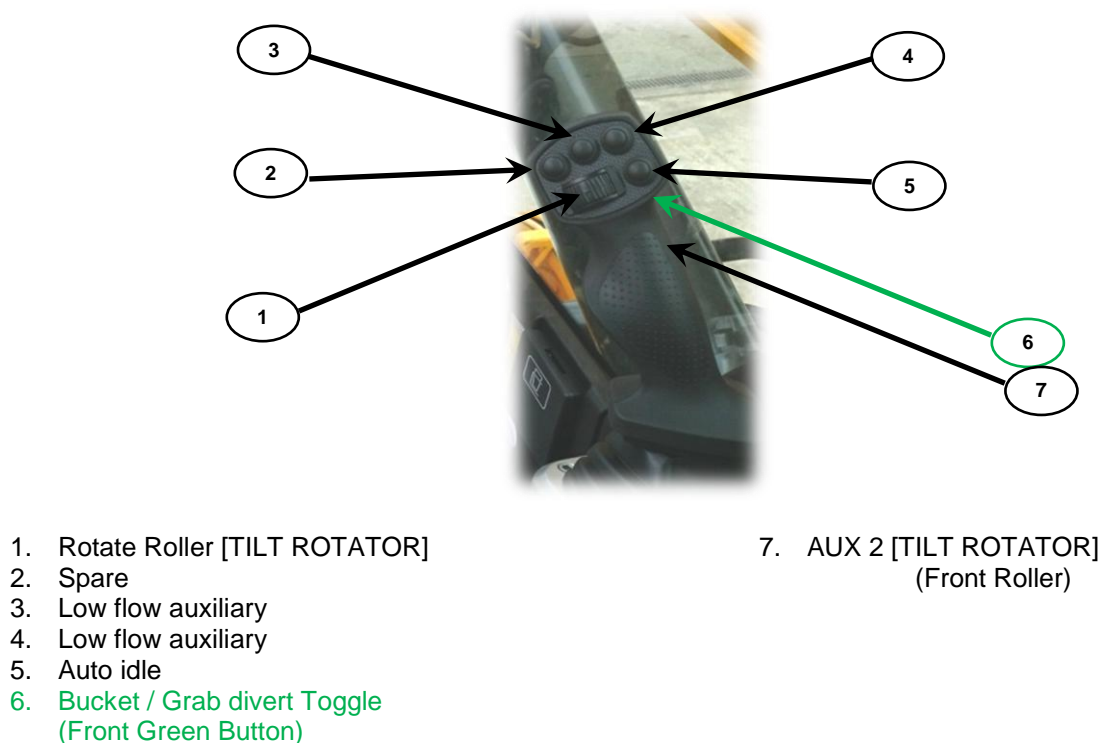


Figure 9 - Right hand lever

12.5 Display

NOTE: All the operating controls for the excavator arm are the same for rail use as construction site use, refer to the JCB JZ235 operator hand book.

Once the screen has booted up, the display changes to the Initial Screen Pages.

12.5.1 Screen Surround





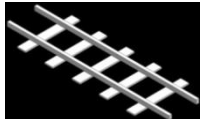


Figure 10 - Screen Surround






The round buttons are F1, F2, F3 and F4 (from left to right). The four arrows are directional. The “ok” button is required in some instances, as detailed in this document.

NOTE: All screens detailed from here, whilst within the unit housing shown above, are shown without the surround for clarity.

12.5.2 Screen Icons

Brief descriptions of the function of each icon displayed on the screen are given in the table below.

Icon	Name	Function
	Hare Speed	The hare speed icon will be displayed to indicate the fast travel state of the machine.
	Tortoise Speed	The tortoise speed icon will be displayed to indicate the slow travel state of the machine.
	Rail Axles	On the main screen page only, the rail axles icon is displayed to identify the rail axles control button.
	Axle Lock On	The green axle lock icon is activated by the physical lock system being currently on.
	Axle Lock Off	The red axle lock icon is activated by the physical lock system being currently off.

Icon	Name	Function
	Parking Brake On	The green parking brake icon is activated by the physical brake system being currently on.
	Parking Brake Off	The red parking brake icon is activated by the physical brake system being currently off.
	Axle Up/Down Arrows	This icon is displayed on the front/rear rail axle control screens once the system is prepared for their movement.
	Horn Operational	This icon is shown at the front screen and main menu pages only, indicating the horn is not muted.
	Horn Muted	This icon is shown at the front and main menu pages only, indicating the horn has been muted.

12.5.3 Initial Screen Pages

Once the screen is powered with 8-32V DC, there are two initial screen pages that will always be displayed; one as the system boots, and another once it has booted.



Figure 11 - Boot Screen Page

While the system initialises, the image shown above will be displayed. This will remain as the only displayed screen page for approximately 5 seconds.

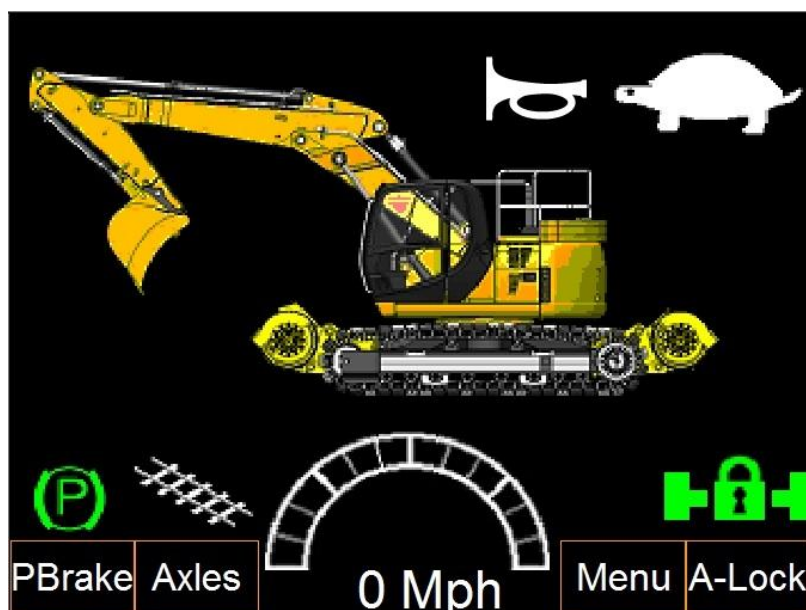


Figure 12 - Main Screen Page

After the Display has finished booting, the main screen page will display as shown above.

As this is the initial page of the system, the access to "Axles" (for rail axle control functions) and "Menu" can only be obtained when this page is displayed, using the F2 and F3 buttons respectively. Similarly, this is the page displayed after all possible "ESC" functions have been used to return to previous pages.

It is only on this page that it is possible to control the Axle lock and parking brake components of the system using the function keys on the front of the display. The F1 button will toggle the state of the parking brake with a 2 second delay from the button press to the actuation of the brake system.

The F4 key will toggle the system's axle lock, the main menu of the display is accessed on this screen by pressing the F3 button, and the rail axle control pages are accessed using the F2 button.

The horn icon shows if the horn is muted or not (a red cross is added when muted).

12.5.4 Travel Control

Tortoise/hare travel speed is also given on this page, along with a speedometer.



Figure 13 - Speedometer

The speedometer numerically displays the current speed of the machine in miles per hour, and fills the gauge from green to red over 12 increments as the speed increases as shown above.

12.5.5 A-Lock

All travel on rail track must be carried out with the axle unlocked.

By operating the A-Lock (axle lock) button the axle can be locked; this will provide greater stability whilst carrying out stationary rail-mounted operations.

12.5.6 PBrake

NOTE: ALWAYS APPLY THE PARK BRAKE BEFORE LEAVING THE CAB.

All travel on rail track must be carried out with the park brake off, by operating the Pbrake (park brake) button the brake can be activated whilst stationary or while moving; this will provide greater braking capability whilst carrying out travelling rail-mounted operations.

12.5.7 Rail Axle Control

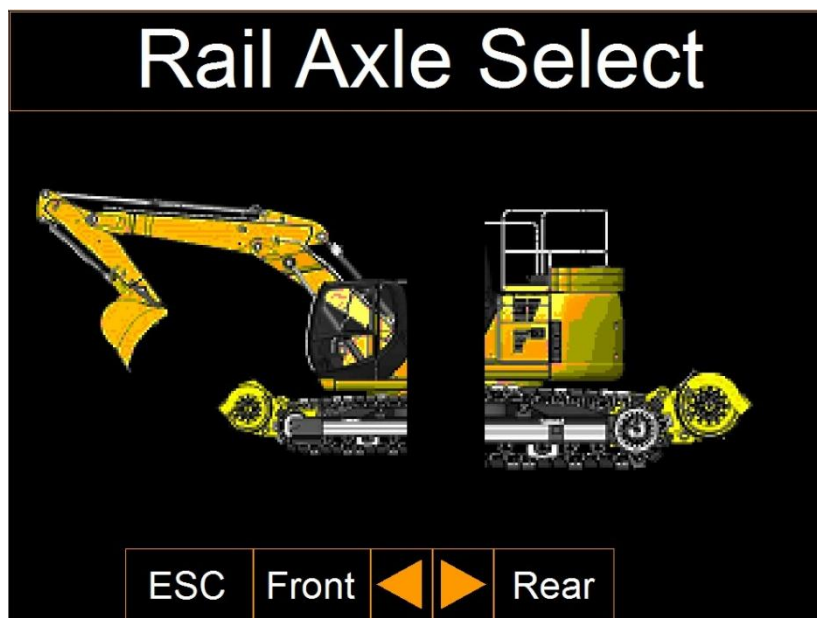


Figure 14 - Rail Axle Selection Page

Having selected the Rail Axles option from the main screen page using the F2 button, the screen will display the "Rail Axle Select" page as above. The "ESC" function is activated by the F2 button, and will return the system to the main screen page when utilised.

To allow the machine to travel in rail mode or return to road travel mode, the rail axles must be deployed or retracted respectively. As each axle can only be operated independently, select the front or rear axle use the "left" arrow to select the front, and the "right" arrow to select the rear. Once the required axle is selected, hold the "ok" button to allow the vertical movement of the chosen axle.

The current status of the axles is displayed on the main screen page, the "Rail Axle Select" page, and "Front/Rear Rail Axle Control" page:

- The axles will be shown as UP when they are no longer sensed by the system as down, and will be coloured yellow.
- The axles will be shown as DOWN and coloured green when the system's sensors have indicated they are down.

12.5.8 Axle Selection



Figure 15 - Front/Rear Axle Selection Page

Upon selecting the required rail axle, the other half of the machine will become hidden, and the screen will display as either of the two states shown above.

12.5.9 Axle Control

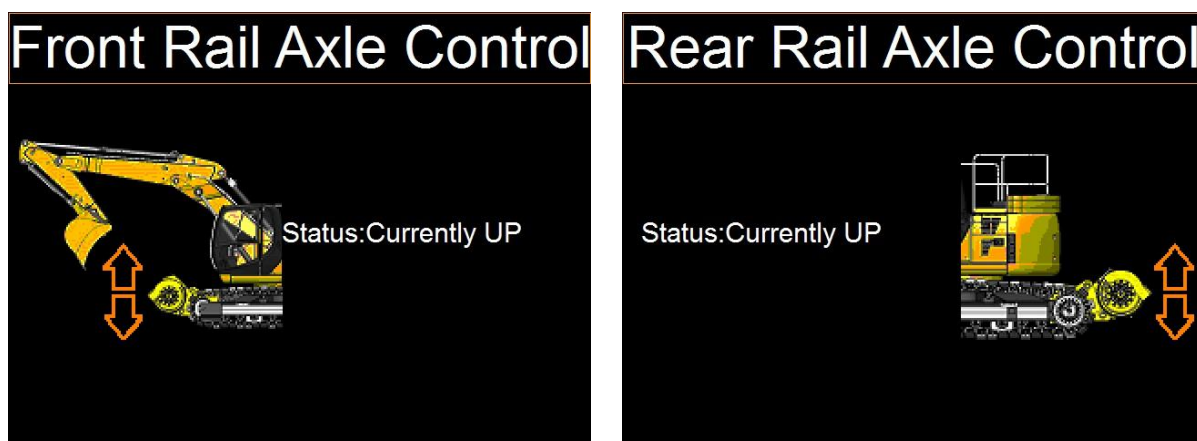


Figure 16 - Front/Rear Axle Control Page

After selecting the required axle, while holding the “ok” button the screen will change to the control pages as shown above. The current status of the axles is described next to the images of the machine. The icon of two arrows next to the axles indicates that the system is ready and primed for their movement up or down.

To raise or lower the axles, press the rail axle control button to select the axle you wish to operate, then operate the dozer up/down lever, forwards to lower the rail axle or backwards to raise it. To raise/lower the other axle press the rail axle control switch into the alternative position then operate the blade lever in the same way.

NOTE: TO ENABLE THE RAIL AXLES TO BE DEPLOYED OR RETRACTED THE PROLEC RCI MUST HAVE 'DIG MODE' ENABLED AND CAN NOT BE IN LIFTING MODE.

THE PROLEC LIFT WATCH RAIL RCI IS AN INHERENT AND INTEGRAL SYSTEM WITHIN THE RAIL-ABILITY SAFETY SYSTEMS ON THE MACHINE. COMPLETE FAMILIARITY WITH THE PROLEC OPERATION MANUAL IS VITAL IN COMBINATION WITH THIS MANUAL TO HAVE A COMPLETE UNDERSTANDING OF THE MACHINES SAFETY FEATURES AND OPERATIONAL INTERLOCKS.



Figure 17 - Axles Down Display

The machine will not travel on rail if both axles are not fully deployed, confirmed green.

The machine is still operated by forward/reverse lever as on a construction site. However, when travelling on rail only the right hand drive lever/pedal is required to be pushed in the direction of travel required to travel the machine under normal conditions. This is reversed each time the machine is slewed 180°. If the left hand lever is pushed the system will ignore it.

12.5.10 Main Menu

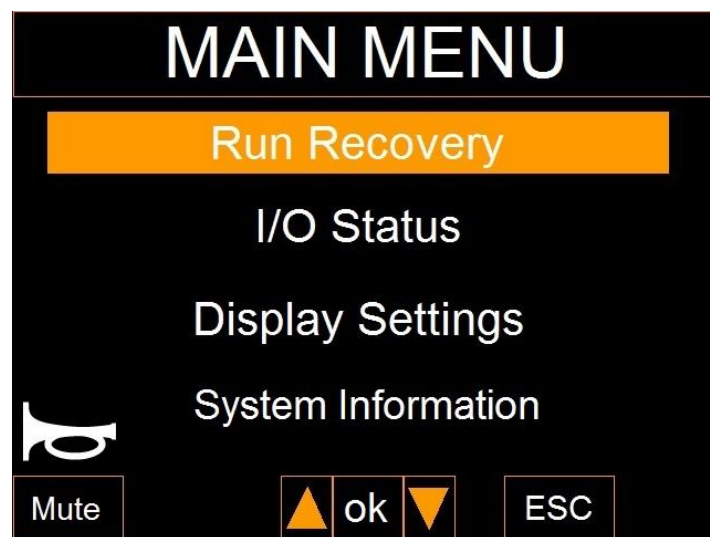


Figure 18 - Main Menu Page

Having pressed the F3 function key on the main screen the main menu will be displayed as shown above. There are 4 possible selections to make at this screen, and it is possible to scroll through the selections using the up and down arrow keys. The selected option will be highlighted orange. To access the item of the menu, press “ok” when the item is highlighted.

12.5.11 Run Recovery

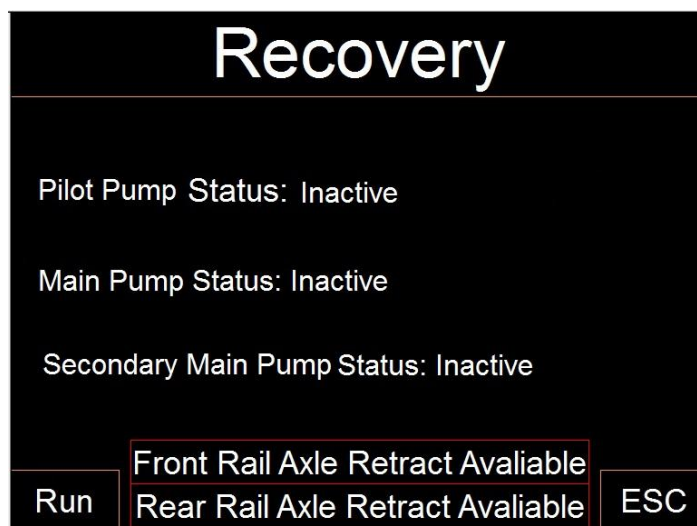


Figure 19 - Run Recovery Page

The "Run Recovery" page of the main menu will display the page shown above. This screen allows operation of the recovery pump to assist in the rescue of the machine from whatever position it requires recovery from. To run the pump, press and hold the F1 key, noting the status of the system as it is operated. There are three pumps that will operate while the key is pressed, activating in 1 second intervals from pilot pump, to main pump, to secondary main pump. The status of rail axle movement availability is also given.

12.5.12 Emergency Recovery

If the machine breaks down in such a position that it is likely to obstruct an adjacent line or cause an accident or damage to the railway infrastructure or any other vehicle, it is important that the machine is placed in a safe position as soon as possible. For this reason the excavator has been fitted with an electro-hydraulic power system and tow bar by which another machine can tow it to safety.

Instructions on how the auxiliary system works are described below. Read and understand these instructions so that in the event of a machine failure you the machine can be out in a safe position:

- Slew the machine so that the arm is parallel to and clear of any adjacent line with the counterweight facing the vehicle that is to be used for towing.
- Lower the boom so that the highest point is no higher than the top of the cab.
- Connect the failed machine and recovery vehicle together with the approved tow bar.
- Release the axle lock stabilisers of the failed machine.
- **ONLY RELEASE THE FINAL DRIVE SHAFT SPLINES ON THE FAILED MACHINE ONCE THE TOW BAR HAS BEEN CONNECTED TO THE RECOVERY VEHICLE OTHERWISE THE MACHINE MIGHT RUN AWAY.**
- Ensure that towing is carried out at approximately 2 mph as the recovery vehicle has to brake for both vehicles and at a higher speed braking distance would be greatly increased.
- Switch on machine ignition switch.
- Switch Prolec on and place in override for duration of the recovery. (if Prolec lift watch RCI is fitted)
- When the recovery pump is running the auxiliary valve block on the machine is operational this provides the following essential functions for recovery:
 - Raise and lower of main arm lift ram;
 - Slew left and right;
 - Arm knuckle left and right;
 - Raise front rail gear/blade trolley;
 - Raise the rear rail gear.
- Operate the machine controls in the usual way to bring the machine into travel gauge to prepare for towing.

WARNING: TO ENSURE THE MACHINE IS COMPLYING WITH THE W6A GAUGE REQUIREMENT BEFORE TRAVELLING ON RAIL IT IS ESSENTIAL THAT THE MACHINE IS SLEWED SO THAT THE UPPER STRUCTURE IS PARALLEL TO THE LOWER STRUCTURE/RAIL AND THAT THE CAB DOOR IS SHUT.

WARNING: TO GUARANTEE THE MACHINE IS COMPLYING WITH THE W6A GAUGE REQUIREMENT BEFORE TRAVELLING ON RAIL IT IS ALSO ESSENTIAL THAT THE ARM IS POSITIONED LOWER OR EQUAL TO THE HEIGHT OF THE CAB. THIS IS TO ENSURE OVERHEAD STRUCTURES ARE NOT STRUCK. THE HEIGHT LIMITER FITTED TO THE MACHINE CAN THEN BE SET AND ACTIVATED TO MAINTAIN THIS POSITION.

Failure to comply with these requirements may result in severe damage to the machine and/or the rail infrastructure.

12.5.13 I/O Status

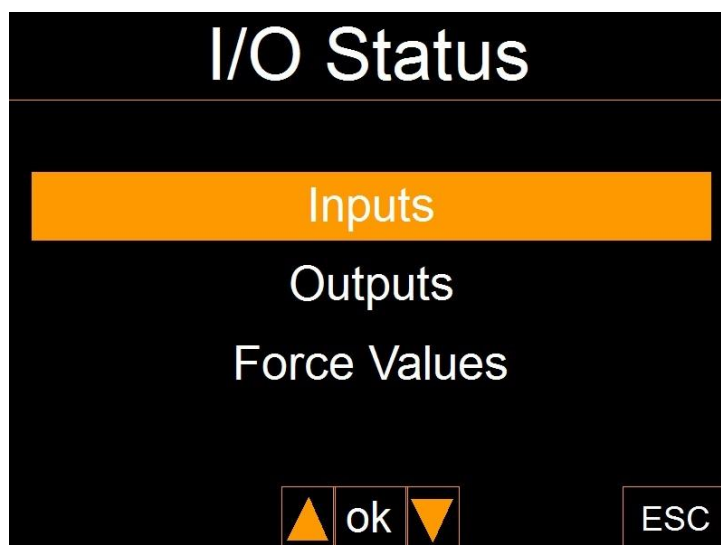


Figure 20 - I/O Status Selection Page

Upon selecting the "I/O Status" option from the main menu, a similar menu system is used to select "Inputs" or "Outputs" for their respective status lists.

Inputs Status		Outputs Status	
b_IRatedCapacityIndicatorActive	Off	b_RailAxleFrontDownOk	Off
b_IRatedCapacityIndicatorOverload	Off	b_RailAxleRearDownOk	Off
b_IHorn	Off	b_SQBrakeUnloader	Off
b_ITravelForward	Off	b_SQAxleLock	Off
b_ITravelReverse	Off	b_SQRailAxleFrontDivert	Off
Pg1 ◀		▶ Pg2	
ESC		ESC	

Figure 21 - Inputs/Outputs Status Page

On the Inputs/Outputs status pages, the important system variables will be listed, with their current status noted on the right hand side. Their status as "On", "Off", or "Error" is updated in real time. To index through the pages, use the left and right arrow keys to jump from page to page. Use the F4 key for "ESC" to return to the I/O Status menu page.

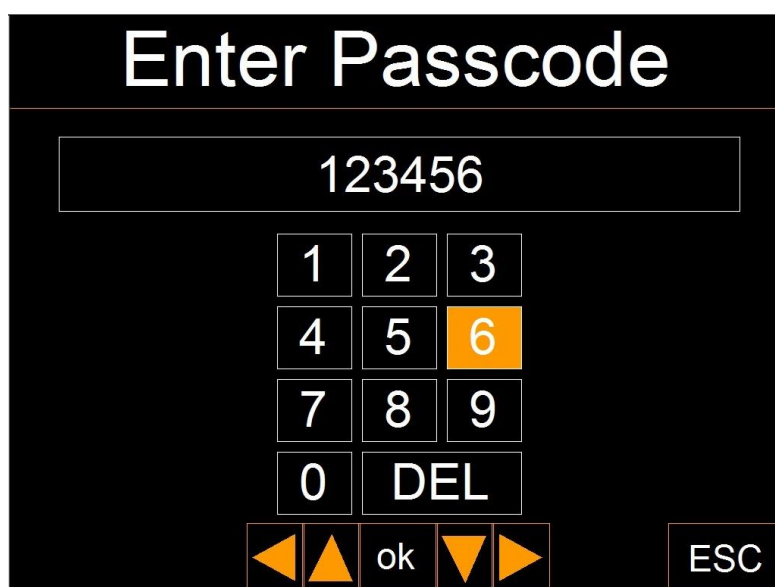


Figure 22 - Force Values Password Page

To allow access to the “Force Values” page, the appropriate 8 digit pass code must first be entered when attempting to access the page via the main menu. The up, down, left, and right keys on the screen dial will navigate through the numbers, once the required number is selected, press the “**ok**” button to enter it as a pass code digit. Highlighting and using the “DEL” button will remove the previously entered pass digit. The F4 key will return the screen to the main menu page. Once the key has been entered, it will not be required to be re-entered unless the system is shutdown (at vehicle ignition off, for example).

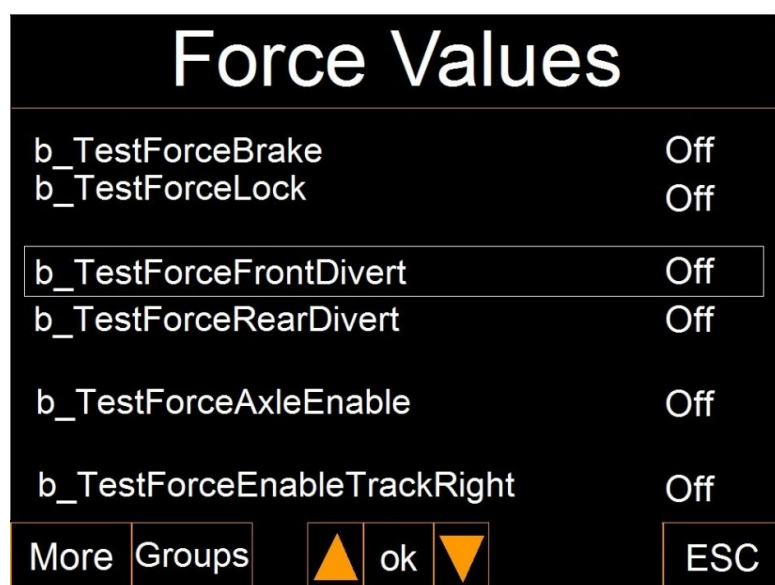


Figure 23 - Force Values Page

Having entered the correct pass code (different from the Gauge Locks page code), hold the “**ok**” button to activate the required outputs, using the up and down arrows to navigate through the options, and F4 to return to the I/O Status menu page. Use the F1, F2, and F3 keys to access more system variables, and groups of variables value forcing pages respectively at the initial force values page. The “**ok**” button will set the outputs on or off, and keep them set until they are reset by returning to the page to toggle their state with the “**ok**” button input. These pages must only be used for vehicle component testing and initialisation; there should be no need to access these pages under normal operation of the system.

12.5.14 Display Settings

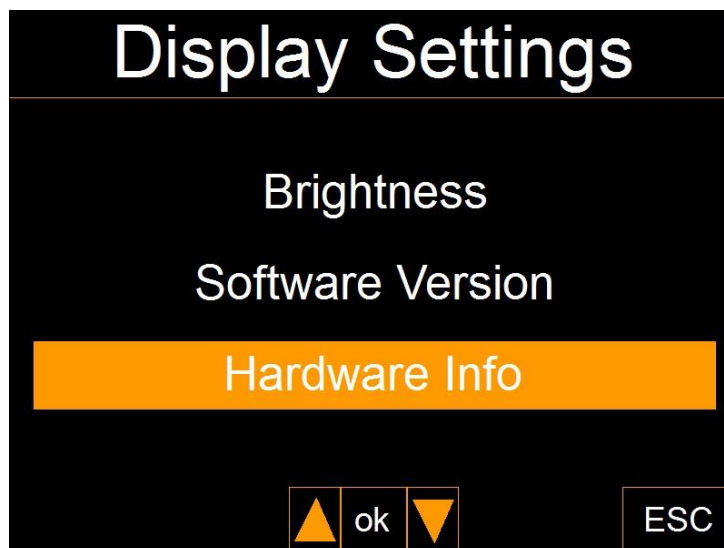


Figure 24 - Display Settings Page

Using the “Display Settings” option in the main menu will display the page shown above. At this screen it is possible to change the brightness of the screen, view the information about the software version of the display screen, or view the hardware information.



Figure 25 - Brightness Page

Using the left and right arrow keys it is possible to decrease and increase the screen brightness respectively. Similarly, using the F1 and F2 keys will change the brightness to 100% or 50%.

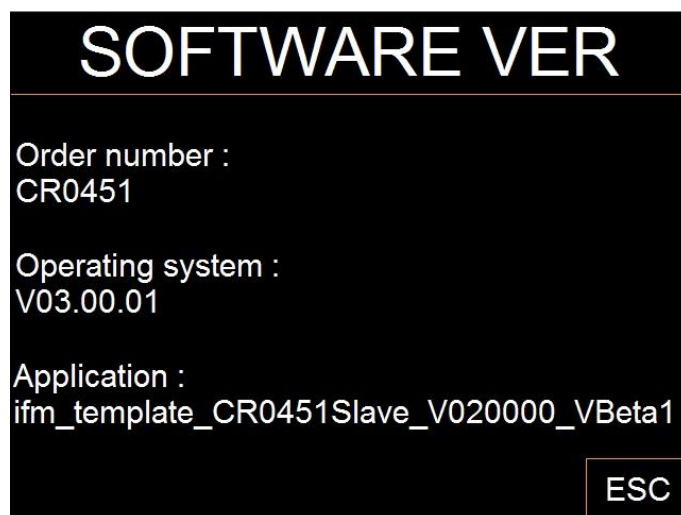


Figure 26 - Software Version Page

On the software version page, the “Order number” information displays the hardware model number of the display. The “Operating system” and “Application” information give information as to the firmware and operating software versions used by the screen in the system. These are displayed for reference only.



Figure 27 - Hardware Info Page

Accessing the “Hardware Info” option of the main menu will show the page above on the screen; this is simply for reference to give hardware information. Using the “**ok**” button will also return the screen to the main menu as with the “ESC” key.

12.5.15 System Information



Figure 28 - System Information Page

Having accessed the "System Information" option from the main menu, the screen will display as shown above. Use the F4 key for "ESC" to return to the main menu page.

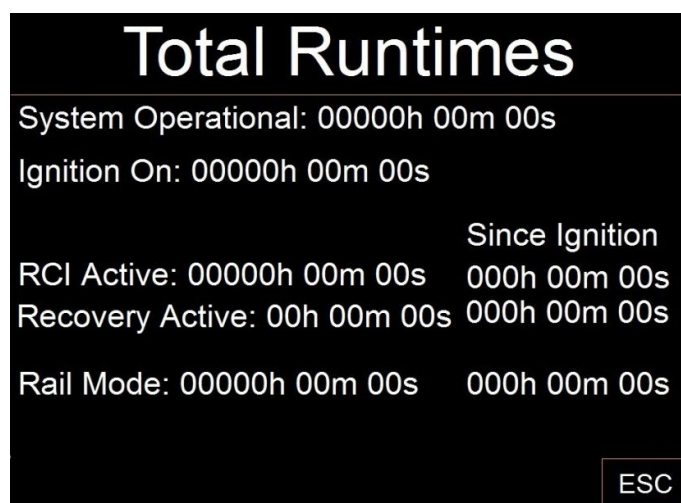


Figure 29 - Runtimes Page

The "Runtimes" option of the "System Information" menu will display the page above. The times are updated constantly, and apart from the "since ignition" values are retained in the memory of the system even after shutdown.

The "RCI Active" values are in reference to the Prolec system components, the "Recovery Active" values are increased only with the operation of the recovery pumps, and "Rail Mode" time is incremented only when both rail axles are considered fully deployed by the system.

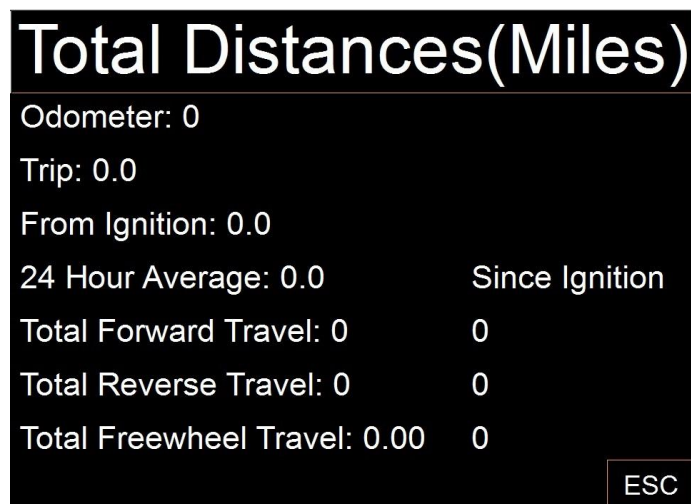


Figure 30 - Total Distances Page

Choosing the "Total Distances" option from the "System Information" menu displays the information above. All values are rail travel distances:

- The Odometer reading is always incremented by any rail travel of the vehicle for the entire time the system has been operational.
- The "Trip" value is arbitrarily reset to 0 by the operator from the main screen page or if it reaches a reading over 1000 miles.
- The "From Ignition" travel distances are the only other distances besides the "Trip" meter distance that can be reset, and are only reset when ignition is powered off.

The obviously larger recorded distances such as the odometer reading and forward/reverse travel distances are only given as whole integers. Smaller distances such as the recorded trip distance, distances from ignition, 24 hour average, and the "Freewheel" travel will be recorded and displayed up to 6 significant figures (potentially 9999.99) with up to 2 decimal places.

13 Pre-Operation Actions

13.1 Requirements

It is the responsibility of the operator to perform a pre-operation inspection and routine maintenance.

Scheduled maintenance inspections shall be performed by qualified service technicians, according to the manufacturer's specifications, governmental regulations and the requirements listed in the Service Manual.

Repairs to the machine may only be made by a qualified service technician, according to the manufacturer's specifications. After repairs are completed, the operator must perform a pre-operation inspection again before going on to the function tests. If in doubt, contact Rail-Ability Ltd.

13.2 General

- Learn and practice the principles of safe machine operation contained in the manuals referenced in Para. 4 and this operator's manual before carrying out these inspections.
- Avoid hazardous situations.
- Always perform a pre-operation inspection prior to use.
- Only use the machine as it was intended.

The pre-operation inspection is a visual inspection performed by the operator prior to each work shift. The inspection is designed to discover if anything is apparently wrong with a machine before the operator performs the function tests.

The pre-operation inspection also serves to determine if routine maintenance procedures are required. Only routine maintenance items specified in this manual may be performed by the operator.

If damage or any unauthorised variation from factory delivered condition is discovered, the machine must be tagged and removed from service.

Refer to the list in the Inspection section below and check each of the items in turn.

13.3 Inspection

- ☐ Ensure that the Operator's and Service manuals are complete, legible and in the storage container located in the cab.
- ☐ Ensure that all decals are legible and in place. See Decals section.
- ☐ Ensure gear shift lever is in neutral.
- ☐ Check engine and related components (e.g. radiator, alternator, belts, etc.). See Manual detailed in section 4.
- ☐ Check for engine oil leaks and proper oil level. Add oil if needed. See Service Manuals.
- ☐ Check for hydraulic oil leaks and proper oil levels. Add oil if needed. See Maintenance section.
- ☐ Check condition of axles, transmission and track.
- ☐ Check operation of service and parking brake. See Manual detailed in section 4.
- ☐ Check operation of the road and rail lights and warning beacons.
- ☐ Check for battery fluid leaks. See Service Manuals.

- ☐ Check cab windscreen and wipers.
- ☐ Check all electrical plugs are connected and hydraulic connections are coupled.

Check the following components and areas for damage, improperly installed, loose or missing parts and unauthorised modifications:

- ☐ Electrical components, wiring, electrical cables and earth straps.
- ☐ Hydraulic power unit, tank, hoses, pipes, fittings, cylinders and manifolds.
- ☐ Batteries and connections.
- ☐ Fuel and hydraulic tanks.
- ☐ Turntable drive motor.
- ☐ Boom wear bushes.
- ☐ Proximity switches, alarms and horns.
- ☐ Nuts, bolts, pins and other fasteners.
- ☐ Lubrication points.
- ☐ Tow bar.
- ☐ Fire extinguisher.
- ☐ Rail wheel hubs, treads, flanges and rail sweepers.
- ☐ Ladders, steps and hand rails.
- ☐ Guards and covers.

Check the entire machine for:

- ☐ Cracks in welds or structural components.
- ☐ Dents or damage to machine.
- ☐ Excessive wear, rust, corrosion or oxidation.

Ensure that all structural and other critical components are present and all associated fasteners and pins are in place and properly tightened.

- ☐ Following inspection, ensure that all compartment covers are in place and latched.

13.4 Completion

If any routine maintenance has been identified in these pre-operation actions, carry it out as specified in the Routine Maintenance section of this manual.

If no routine maintenance is required, carry out the Function Tests detailed in this manual.

14 Routine Maintenance

14.1 Requirements

It is the responsibility of the operator to perform routine maintenance as required by the pre-operation inspection.

Scheduled maintenance inspections shall be completed by qualified service technicians, according to the manufacturer's specifications, governmental regulations and the requirements specified in the Service Manual.

14.2 General

- Only routine maintenance items specified in this manual shall be performed by the operator.
- Use only manufacturer's original replacement parts. Contact Rail-Ability Ltd if in doubt.
- Machines that have been out of service for more than three months must receive at least the Quarterly Inspection before they are put back into service (see Service Manual in section 4).

Carry out the maintenance below as required by the Pre-operation Actions.

14.3 Engine Oil Level

Maintaining the proper engine oil level is essential to good engine performance and service life. Operating the machine with an improper oil level can damage engine components.

NOTICE Check the oil level with the engine off.

Refer to the OEM manuals detailed in section 4.

14.4 Hydraulic Oil Level

Maintaining the hydraulic oil at the proper level is essential to machine operation. Improper hydraulic oil levels can damage hydraulic components.

Daily checks allow the inspector to identify changes in oil level that might indicate the presence of hydraulic system problems.

NOTICE Perform this procedure with the boom in the stowed position.

1. Visually inspect the oil level in the hydraulic tank. The sight gauge is located on the side of the hydraulic oil tank (right hand side of machine cab). With the boom in its stowed position, the hydraulic oil level should be half way up the sight gauge.
1. Add oil if necessary using **Hydraulic oil type ISO 46 Grade**. Do not overfill.

14.5 Batteries

Proper battery condition is essential to good engine performance and operational safety. Damaged cables and connections can result in engine component damage and hazardous conditions.



Electrocutation hazard.

Contact with hot or live circuits may result in death or serious injury. Remove all rings, watches and other jewellery.



Bodily injury hazard.

Batteries contain acid. Avoid spilling or contacting battery acid. Neutralise battery acid spills with baking soda and water.

1. Put on protective clothing and eye wear.
2. Be sure that the battery cable connections are tight and free of corrosion.
3. Be sure that the battery retaining fasteners are in place and secure.

14.6 Rail Wheels and Profiles

Maintaining the rail wheels in good condition is essential to safe operation and good performance. Excessive flange and/or tread wear could result in machine derailment and tip-over. Component damage may also result if problems are not discovered and repaired in a timely fashion



Bodily injury hazard.

Excessively worn rail wheels can develop sharp burrs due to material migration.



Tip-over hazard.

Do not attempt to re-machine and/or re-apply heat treatment to the rail wheels.

1. Check rail wheels friction drive hubs for missing or loose bolts.
2. Check condition of rail wheel treads and flanges for pitting scoring, bruising, flat spots or other damage.
3. Check that no cracks, flats or scoring are visible.

Refer to Service Manual listed in section 4 for further checks and limits.

14.7 Fuel Leaks

Failure to detect and correct fuel leaks will result in an unsafe condition. An explosion or fire resulting from a fuel leak may cause death or serious injury.



Explosion and fire hazard

Engine fuels are combustible. Inspect the machine in an open, well-ventilated area away from heaters, sparks, flames and lighted tobacco. Always have an approved fire extinguisher within easy reach (one is also fitted inside the machine cab).

1. Perform a visual inspection in the areas surrounding the fuel tanks, hoses and fittings, fuel pump, fuel filter, fuel injection pumps and fuel injectors.



Explosion and fire hazard.

If a fuel leak is discovered, keep any additional personnel from entering the area and do not operate the machine. Repair the leak immediately.

14.8 Completion

Carry out the Function Tests detailed in this manual.

15 Function Tests



15.1 Requirements

It is the responsibility of the operator to perform Function Tests following Pre-operation Inspection.

15.2 General

The Function Tests are designed to discover any malfunctions before the machine is put into service.

- A malfunctioning machine must never be used. If malfunctions are discovered, the machine must be tagged and removed from service.
- Repairs to the machine may only be made by a qualified service technician, according to the manufacturer's specifications.
- After repairs are completed, the operator must perform a Pre-operation Inspection and carry out the Function Tests again before putting the machine into service. If in doubt, contact Rail-Ability Ltd.

Refer to the sections below and carry out each of the items in turn.

15.3 From the Machine Cab

1. Ensure the gear shift lever is in the neutral position.
2. Turn the ignition key in the cab to position 'two'.
3. Wait for the display to show the immobiliser PIN code entry interface.
4. Enter the correct immobiliser PIN code.
5. Enter the 8 digit sentinel PTS operator number. Ensure that this is correct.

15.3.1 Emergency Stop

6. Press the emergency stop button in the cab.
 - Result: The display will show Emergency Stop Active. The engine will still run.
7. Reset the emergency stop by pulling out the button.

15.3.2 Horn

8. Push the horn button (2) on the right hand lever (Fig.9).
 - Result: The machine horn should sound.

15.3.3 Crawler Drive Braking



THE BRAKES MUST BE ABLE TO HOLD THE MACHINE ON ANY SLOPE IT IS ABLE TO CLIMB.

9. Select low gear and drive forwards slowly.

10. Stop.

- Result: The machine should stop promptly and firmly.

15.3.4 Rail Gear Deployment

11. When instructed it is safe to do so by the machine controller, inspect the On-Tracking access point and ensure that it is suitably prepared.

12. When instructed it is safe to do so by the machine controller, drive the machine to the On-Tracking point and align the machine over the track.

13. Enable lifting mode on the Prolec RCI.

14. Following the instructions in the **Rail Axle Control paragraph**, press the rail axle control button to select the rear axle, then operate the dozer up/down lever, backwards to raise the rail axle.

- Result: The rail gear should not lower.

15. Disable lift mode on the RCI.

16. Following the instructions in the **Rail Axle Control paragraph**, press the rail axle control button to select the rear axle, then operate the dozer up/down lever, forwards to lower the rail axle or backwards to raise it. Move the front rail gear raise/lower lever down.

- Result: The front rail gear will lower onto the rails and lift the machine off the ground.
- Result: The display will indicate when the front rail gear is fully deployed (Green rail wheel).

17. Repeat for the rear rail gear using the previous lever.

18. Move the rear rail gear raise/lower lever down.

- Result: The rear rail gear will fully lift the machine.
- Result: The display will indicate when the rear rail gear is fully deployed (Green rail wheel).

15.3.5 Rail Drive and Rail Braking



PRIOR TO DRIVING ON RAIL, ENSURE THAT THE FRONT STEERING WHEELS ARE STRAIGHT.

19. Select tortoise gear. Push the right travel lever forward to travel forwards slowly.

- Result: The machine should move forwards.

20. Release the lever.

- Result: The machine should stop promptly and firmly.

21. Press the park brake button.



THE BRAKES MUST BE ABLE TO HOLD THE MACHINE ON ANY SLOPE IT IS ABLE TO CLIMB.

22. Always close the cab door.

15.4 Completion

If the machine is to be used, carry out the Workplace Assessment detailed in this manual.

16 Workplace Assessment



16.1 Requirements

It is the responsibility of the operator to perform Workplace Assessment following Function Tests.

16.2 General

The workplace assessment helps determine if the workplace is suitable for safe machine operation. It should be performed by the operator prior to moving the machine to the workplace.

16.3 Assessment

Assess for the following potential obstacles and hazardous situations as they may hurt people, damage both the machine and the boom, and cause the machine to overturn:

- Hazardous locations.
- OHLE power cables.
- Overhead and high voltage conductors.
- Obstructions, including:
 - Building walls
 - Balconies
 - Eaves
 - Scaffoldings
 - Tree branches.
- Any items that may lift the machine.
- Other machines.
- Inadequate surface support to withstand all load forces imposed by the machine.
- Wind and weather conditions.
- The presence of unauthorised personnel.
- Any possible unsafe conditions.
- Cant – not to exceed 150 mm.
- Ballast shoulder – not too high or too low.
- Deep cess or soft cess.
- Drainage routes, troughing routes and other services/cables.

Make sure that there is no risk of elements falling on the operator or on the boom and take the right precautions to prevent it.

Ensure any items assessed as hazardous above are addressed before the machine can be used.

16.4 Completion

If the machine is to be used, carry out the Operating Instructions detailed in this manual.

17 Operating Instructions



17.1 Requirements

It is the operator's responsibility to follow all the safety rules and instructions in this Operator's Manual and all the other documents listed in section 4 of this manual.

Only trained and authorised personnel should be permitted to operate the machine.

If more than one operator is expected to use a machine at different times in the same work shift, they must all be qualified operators and are all expected to follow all safety rules and instructions in this Operator's Manual and all the other documents listed in section 4 of this manual.

17.2 General

A malfunctioning machine must never be used. If malfunctions are discovered, the machine must be tagged and removed from service.

Prior to use, ensure the following:

1. Learn and practice the principles of safe machine operation contained in this operator's manual.
2. Perform Pre-operation Actions.
3. Perform Function Tests.
4. Carry out a Workplace Assessment.

These Operating Instructions detail each aspect of machine operation.

17.3 Emergency Stop

Ensure that all personnel, either operating or working alongside this machine, are aware of the locations and function of the emergency stop button.

The emergency stop button is located in the machine cab.

The emergency stop function provides a facility to isolate machine functions in the event of an emergency situation.

- To stop all functions push the Red emergency stop button to the 'OFF' position.

An indicator light on **the main panel** will illuminate when the emergency stop button has been depressed. The engine will continue to run when the emergency stop button has been pressed.

Repair any function that operates when any of the emergency stop buttons are depressed.

- To reset all functions, pull out the Red emergency stop button that has been depressed.

17.4 Deploying the Rail Gear

The rail gear can only be deployed using the controls located in the machine cab as detailed in the Rail Axle Control section of this manual.

17.5 Drive on Rail



PRIOR TO DRIVING ON RAIL, ENSURE THAT THE AREA OF RAIL IN FRONT AND BEHIND YOU IS CLEAR OF ANY OBSTRUCTIONS OR PERSONNEL. SOUND THE HORN AND USE A MACHINE CONTROLLER OR 'BANKSMAN' IF NECESSARY.

When on rail, with the front and rear rail gear fully deployed, the machine can be driven forwards and backwards using the cab rail drive controls. If the boom is fully stowed, 1st, and 2nd gears are available.

- The right hand drive lever must be used to travel and enable drive.
- To move the entire machine forwards, select tortoise on the display. Gently press the lever in the forward direction to reach the desired speed. Higher speeds can be obtained by further selecting rabbit on the display and press the accelerator if required.
- To move the entire machine backwards, select tortoise on the display. Gently press the lever in the rearward direction to reach the desired speed. Higher speeds can be obtained by further selecting rabbit on the display and press the accelerator if required.

17.6 Road Mode

Once the boom has been fully stowed and both front and rear rail gear have been fully raised, the machine will shut down the rail lights and rail mode systems and activate the road lighting systems automatically.

The machine is now in road mode and can be driven using the cab controls. Follow the Off-Tracking procedure described in this manual and the relevant Rail-Ability manual.

17.7 Work Lights

The work lights on the booms can be switched on and off by using the pushbutton in the cab.

- To switch the work lights ON, push the button in the cab.
- To switch the work lights OFF, push the button in the cab.



LED working lights have been fitted to the Boom and Cab to keep the current requirements low at 24 volts. Under no circumstances can these be replaced, exchanged or have additional lights added with standard filament type bulbs.

17.8 Restricting the Operating Envelopes

17.8.1 General

It may be necessary to use the slew restriction if the machine is working alongside a rail line which is still in service. This feature prevents the boom from accidentally being slewed over the adjacent track and therefore presenting a significant collision hazard. The slew restriction must be used in these circumstances as follows:

- To set the virtual wall over the left hand side of the machine, with the platform stowed, lock and set the parameters in the machine cab utilising the virtual wall menu screen on the dashboard display panel.
- To set the virtual wall over the right hand side of the machine, with the platform stowed, lock and set the parameters in the machine cab utilising the virtual wall menu screen on the dashboard display panel.

- To set the virtual ceiling above the machine, with the platform stowed, lock and set the parameters in the machine cab utilising the virtual wall menu screen on the dashboard display panel.

Refer to the manual listed in Paragraph 4 for operation of the boom.

17.8.2 Boom



ENSURE THAT THIS FUNCTION IS TESTED FOR CORRECT OPERATION PRIOR TO RELYING ON IT.

The Boom will not work to the exact virtual wall setting and instead is restricted to slew limited sectors. As such, the boom operations on the related side of the machine will be disabled from the centre line of the machine due to unknown load size parameters. This limitation is implemented in relation to ORR defined best practice guidance.

17.9 Load Handling

17.9.1 General



Before manoeuvring the load, verify that the working area is suitable for the boom.

The lifting curves of the capacity plate indicate the maximum load that the boom can lift at a certain radius and at a certain height. During load handling, do not exceed the reach limits given, or the load indicated on the above mentioned charts. If the limits are exceeded, the limiting device will be activated.

17.9.2 Lifting Moment Limiting Device

A characteristic which permits the classification of booms is their lifting capacity or maximum lifting moment. The moment is defined by the value obtained from the weight of the load to be lifted (**kg**) by its distance (**metres**) from the centreline of the boom rotation.

The "lifting moment limiting device" preserves the boom structure from overloads, as it prevents any movement which increases the value of the moment up to the maximum established value.

17.9.3 Manoeuvres of the boom

During load handling with the boom, in a vertical configuration or close to, the operator must refer to the loads indicated on the capacity plates since the limiting device is not particularly sensitive with vertical lifts.

17.9.4 Stow

Press the stow button. All of the incorrect functions and movements will then be disabled to assist the operator.

17.10 After Each Use

Perform the following steps at the end of every work shift.

1. Ensure the boom is fully stowed.
2. Off-Track the machine.
3. Park the machine on a firm level surface, clear of obstruction and traffic at least 3 metres away from the nearest railway lines.

- ## 17.11 On and Off Tracking



The diagram illustrates a T-junction layout with the following dimensions and features:

- Horizontal Dimensions:**
 - Left lane width: 20m
 - Right lane width: 12m
 - Right lane width: 0m (at the bottom)
- Vertical Dimensions:**
 - Top lane width: 25m
 - Top lane width: 22m
 - Top lane width: 18m
 - Bottom lane width: 8m
 - Bottom lane width: 3m
 - Bottom lane width: 0m (at the bottom)
- Other Dimensions:**
 - Radius: R12m
 - Top lane width: 12m
- Vehicle Positions:**
 - Three vehicles are shown in the top lane, moving towards the junction.
 - Two vehicles are shown in the bottom lane, moving away from the junction.

NOTE:
The dimensions shown here are approximate and given for guidance only.

- NOTE: DO NOT ATTEMPT TO MANOEUVRE THE MACHINE WITH THE CRAWLER TRACKS, WHEN THE RAIL GEAR IS SEMI/FULLY DEPLOYED.

WARNINGS (1) WHEN ON TRACKING, CARE MUST BE TAKEN WHEN LOWERING THE BOGIE ONTO THE RAIL HEAD TO ENSURE ALL FOUR WHEELS CONTACT THE RAIL BEFORE THE WEIGHT OF THE MACHINE IS EXERTED ONTO THE TRACK. IF THE MACHINE IS NOT PERPENDICULAR TO THE RAIL WITHIN THE RAIL WHEEL FLANGE TOLERANCE OF THE RAIL AXLES OR SEVERE DAMAGE TO THE TRACK MAY RESULT.

(2) ENSURE THAT THE FRONT TRACK IDLERS ARE CORRECTLY SET TO GIVE ADEQUATE TRACK GAUGE CLEARANCE. 150MM OF CLEARANCE FROM THE UNDERSIDE OF THE TRACK PADS TO THE RAIL HEAD IS REQUIRED TO CLEAR INFRASTRUCTURE (DO NOT OVER TIGHTEN THE TRACKS)

Note: The rail lights will automatically illuminate, the drive travel Joystick will become active and the speedometer will recalibrate for rail mode.

18 Transportation



18.1 General

- ✓ Never lift the machine with a boom.
- ✓ The transport machine must be parked on a level surface.
- ✓ The transport machine must be secured to prevent rolling while the machine is being loaded.
- ✓ Be sure the transport machine capacity, loading surfaces and chains or straps are sufficient to withstand the machine weight. See the serial plate on the machine for the machine weight or the Specification section in this manual.

Towing the machine is not recommended. If the machine must be towed due to failure on track, do not exceed 6 mph.

18.2 Loading

- ✓ Do not drive the machine on a slope that exceeds the slope rating. **See Driving on a Slope in the Operating Instructions section.**
- ✓ If the slope of the transport machine bed exceeds the maximum slope rating, the machine must not be loaded and a suitable transport machine must be obtained.

After the machine is loaded:

1. Ensure that the rail gear remains raised after loading. Only the tracks must be contacting the deck of the transport machine.
2. Ensure that the machine slew brake is applied.
3. Never leave the machine engine running.

18.3 Machine

- ✓ Fold the boom.
- ✓ If the booms are to be laid on the body or on the load, they must be suitably blocked to prevent possible sideways movements.
- ✓ Make sure that the indications about the overall dimensions are respected.
- ✓ NOTE: Implements can be left mounted on the boom only if the overall dimensions are respected; they must be suitably blocked to prevent possible sideways movements.
- ✓ If an accessory is mounted, it must be tied down at all times during transport.
- ✓ Make sure that the rams are within the overall width of the machine and locked by the safety devices.

18.4 Transit

- ✓ Turn the machine ignition key switch to the off position, remove the key and lock the cab doors before transporting.
- ✓ Inspect the entire machine for loose or unsecured items.
- ✓ Use chains of ample load capacity.
- ✓ Use a minimum of 2 chains per side.
- ✓ Adjust the position to prevent damage to the chains and machine.
- ✓ Never chain over the boom, cab or dipper.
- ✓ Only chain to the dedicated identified chaining-down eyes.

19 Attachment Handling



19.1 General

- ✓ Never lift the entire machine with a boom.
- ✓ The machine must be parked on a level surface.
- ✓ The machine must be secured to prevent rolling while the attachment is being demounted.
- ✓ If the attachment is being lifted off, be sure the boom machine capacity, and lifting chains or straps are sufficient to withstand the attachment weight. See the serial plate on the machine for the attachment weight or the Specification section in this manual.
- ✓ Do not demount removable counterweights or the attachment when on a slope.
- ✓ Never demount the attachment with the booms out of the lowered to ground position.
- ✓ Always fully stow the attachment before disengaging the quick hitch.
- ✓ Always recheck the quick hitch.
- ✓ Always recheck the attachment is fastened securely.

19.2 Detaching

After the machine has been stabilised on flat level ground:

1. Disengage the hydraulic, air and electrical connections to the host machine.
2. Disengage the quick hitch.

19.3 Lifting

Never lift the machine.

20 Decals

Part no.	Description	Quantity
28161	Crushing hazard	4
28164	Hazardous materials	1
28171	No smoking	1
A0617	Danger overhead live wires	9
A0623	VAB instruction label	1
A2236	No access under live O.L.E.	1
A2380	Data panel	2
A3973	Engineering Acceptance Certificate	2
A4281	Maintain 3 points of contact	3

For other decals fitted which are marked '817/.....' refer to the OEM Manuals referred to in section 4.

Use the illustrations on the following pages to verify that all decals are legible and in place.

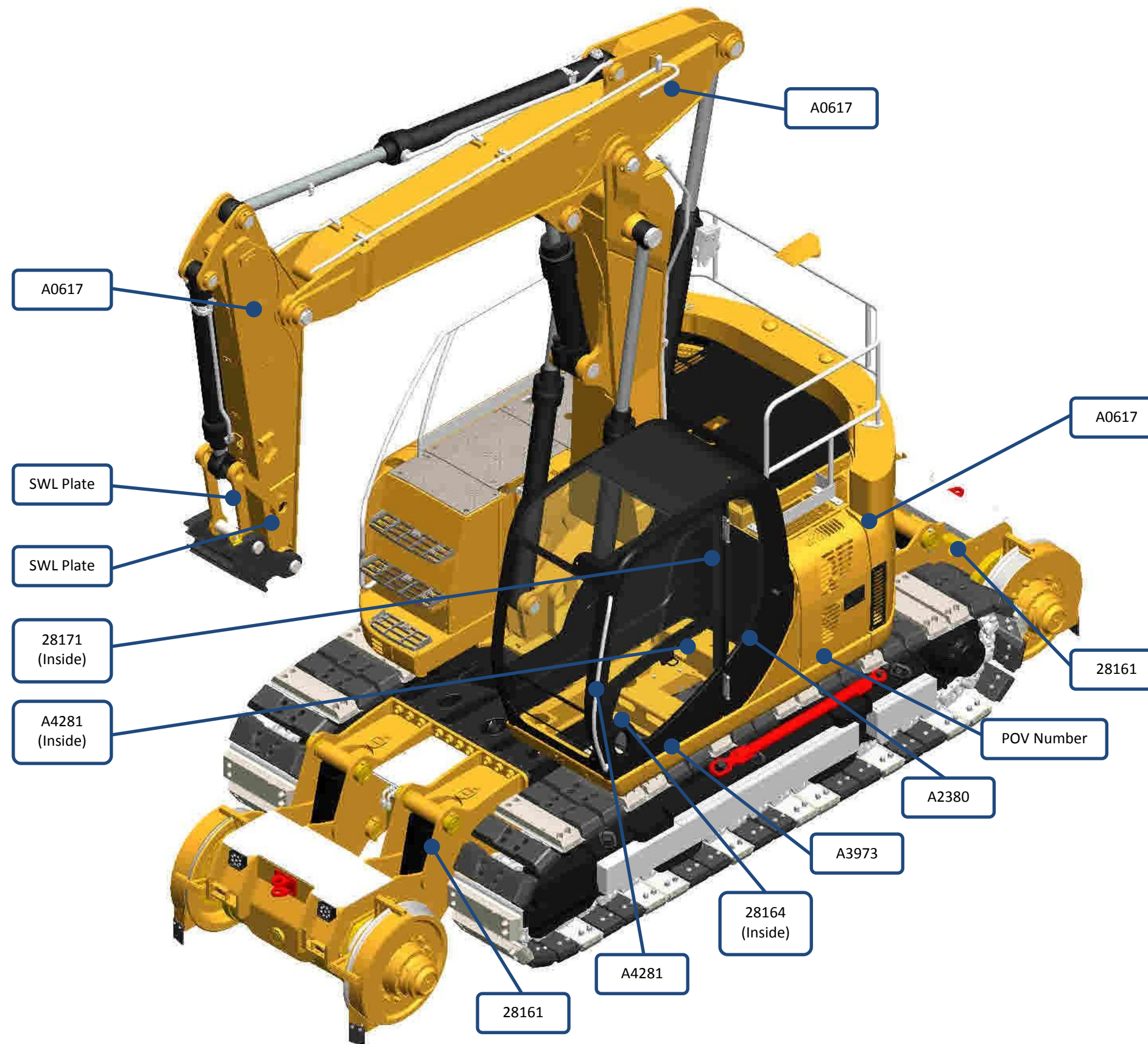


Figure 31 - Base Machine - Front Nearside Isometric View

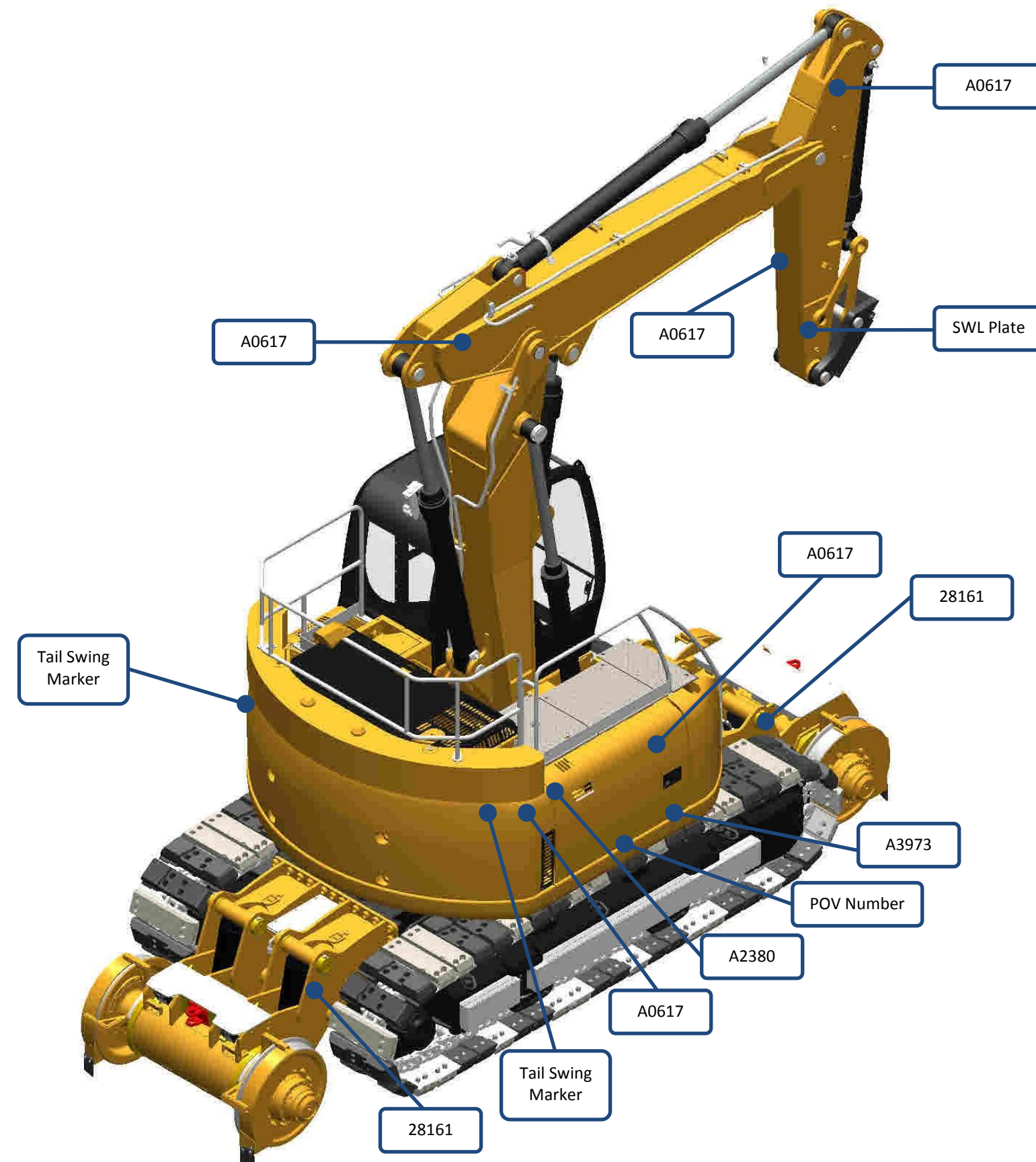


Figure 32 - Base Machine - Rear Offside Isometric View

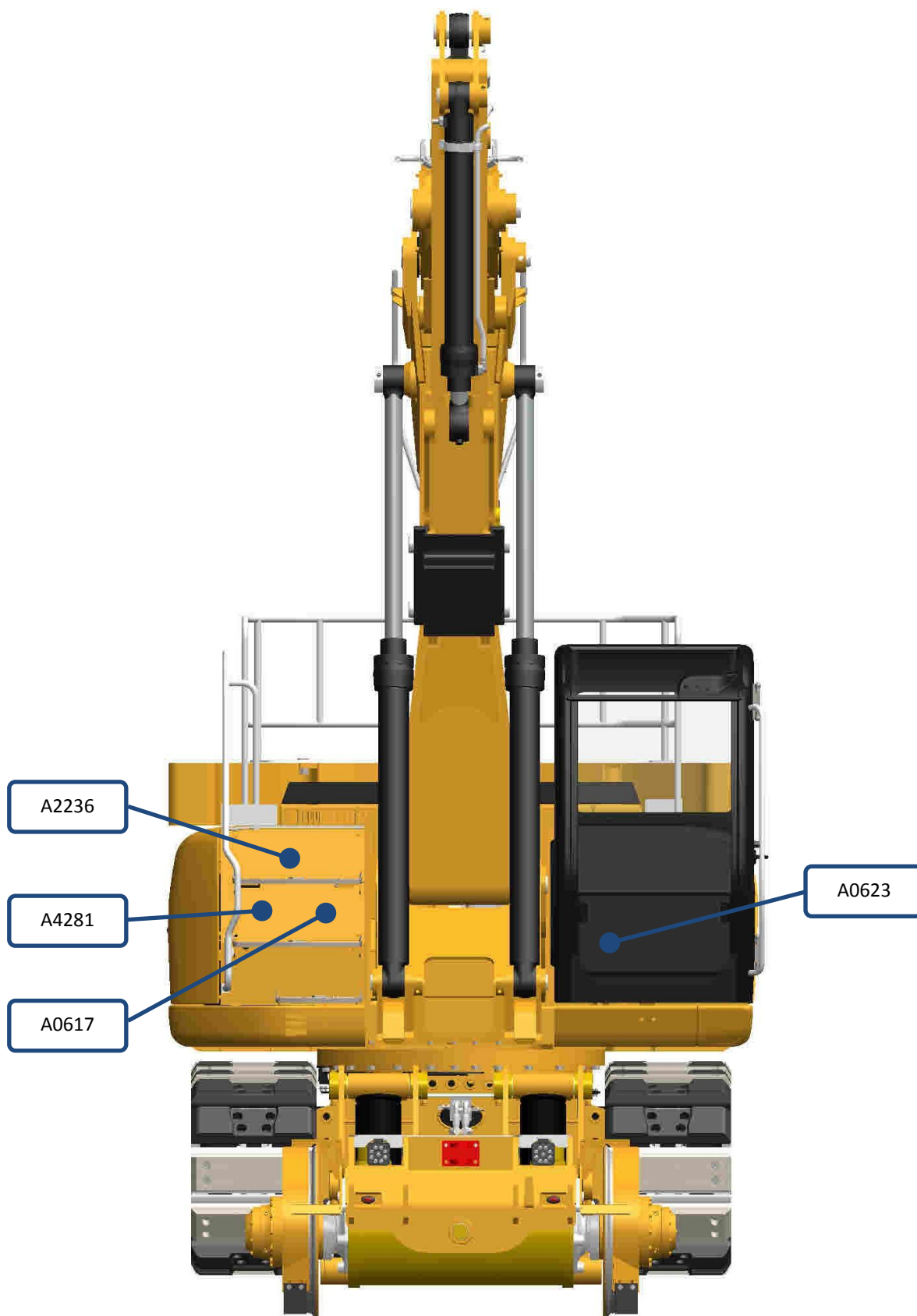


Figure 33 - Base Machine - Front View

21 Specifications

Dimensions	
Maximum height (on rail)	9.250 m
Horizontal reach	7.5 m
Maximum rated capacity	20,000kg
Overall height, stowed (road)	3.750 m
Overall width, stowed	2.863 m
Overall length, stowed	9.960 m
Rail Wheelbase	5.537 m
Front overhang (road)	1.350 m
Rear overhang (road)	1.430 m
Approach angle (road)	21°
Departure angle (road)	21°
Turning radius (road)	0m
Minimum Track Curve Radius	60 m
Ground clearance (rail)	150 mm
Ground clearance (road)	300 mm
Machine deck height (road)	2.150 m
Machine deck height (rail)	2.300 m

Power supply	
Power Source	24 volt D.C.
Batteries	2 x 115 Ah
Controls	Proportional
24 Volt DC outlet at dipper	Standard
Maximum hydraulic pressure	405 bar
Hydraulic tank	120 litres
Fuel tank	290 litres

Weights	
Overall weight	40,000 kg
Maximum weight with auxiliary counter weight	45,000 kg

Environmental data and limits	
Sound power level (machine engine)	L _{WA} 103dB
Sound pressure level in Cab (A-weighted)	77 dB
Vibration	< 2.5 m/s ²
Operating temperature	-5 °C to + 30 °C
Maximum Gradient (rail)	1 in 25
Maximum rail Cant (travelling)	200 mm
Maximum rail Cant (working)	150 mm
Maximum slope rating, stowed position, on tracks	3.0°
Maximum side slope rating, stowed position, on tracks	3.0°